CLINICAL AND ECHO PROFILE IN HEART FAILURE WITH PRESERVED EJECTION FRACTION

Dissertation submitted in partial fulfillment of regulation for the award of M.D. Degree in General Medicine (Branch I)

The Tamilnadu

Dr. M.G.R. MEDICAL UNIVERSITY

Chennai

April 2011

CERTIFICATE

Certified that this is the bonafide dissertation done by ***DR.S.MALLIKA*** *and submitted in partial fulfillment of the requirements for the Degree of M.D., General Medicine, Branch I of the Tamilnadu Dr. M.G.R. Medical University, Chennai.*

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I, Dr. S MALLIKA hereby solemnly declare that the dissertation titled **"CLINICAL AND ECHO PROFILE IN HEART FAILURE WITH PRESERVED EJECTION FRACTION"** was done by me at Coimbatore Medical College and Hospital from September 2009 to September 2010 under the supervision and guidance of **Prof.D.DHARMARAJAN, M.D.D.M (Cardio),**. This dissertation is submitted to Tamil Nadu DR. M.G.R Medical University, towards partial fulfillment of requirement for the award of **M.D. Degree in General Medicine.**

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ACKNOWLEDGEMENT

I sincerely thank the Dean, Coimbatore Medical College and Hospital, **Dr.R.VIMALA, M.D.,** our Medical Superintendent **Dr.Mathivanan M.S., DCH.,** for permitting me to avail the facilities of the college & Hospital for my dissertation work.

I whole heartedly express my sincere gratitude and thanks to **Prof.S.VEERAKESARI.M.D**., Professor of Medicine, Unit chief, Head of the Department of Medicine and my former Heads of the Department of Medicine, Professors **Dr.UMAKANTHAN, M.D., Dr.JAMBULINGAM, M.D and Dr.RAMASAMY, M.D.,** Coimbatore Medical College and Hospital, for being a Source of inspiration, excellent guidance, valuable instructions and help in every stage of study which has made this dissertation work possible. I am indebted to **Prof.D.DHARMARAJAN, M.D.D.M (Cardio),** Professor of Cardiology, Department of Cardiology, Coimbatore Medical College and Hospital for this foresight, guidance, periodical supervision & encouragement to me to do the study.

I sincerely thank all Professors **Dr.NEDUMARAN, M.D.D.M., Dr. S.USHA, M.D., Dr.RAVEENDRAN, M.D.,** for their valuable guidance and kind help.

I am extremely thankful to my Unit Assistant Professors **Dr.KUMAR NATARAJAN.M.D., Dr.V.NEELAKANDAN, M.D.,** and **Dr.R.MANOHARI.M.D.,** for their valuable guidance, reference material and encouragement throughout the study.

I am also thankful to my colleagues who shared their knowledge and also the **PATIENTS** without whose co-operation, this study would not have materialized.

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Introduction

INTRODUCTION

Heart Failure (HF) is a major public health problem that is associated with markedly diminished survival. Heart Failure (HF) has classically been considered to be a Clinical Syndrome associated with Cardiac dilation and impaired cardiac contractility[1].

Several studies have reported that a high proportion of patients with HF are found to have a normal left Ventricular Function and an Ejection Fraction(EF) of more than 50%. This has variously been labeled as Diastolic Heart Failure, "Heart Failure with Preserved Ejection Fraction"(HFPEF)[2] or" Heart Failure with normal Ejection Fraction"(HFnlEF)[6] and is attributed to abnormalities of Diastolic function although the exact mechanism is debated[3,4]. The epidemiology, aetiology and pathophysiology of this condition are reviewed recently.

Prior data suggest that patients who have HF with Preserved Ejection Fraction tend to be older, to be female and to have a history of Hypertension (HT)[2,5].

The EF threshold (or "cutoff") value used to differentiate the Heart Failure patients as Reduced EF and Normal or Preserved EF ranged from 40% to 50% in a variety of studies. What is the ideal

threshold value? Data indicate that patients with an EF between 40% and 50% behave more like patients with EF 40%. The major conclusions of Smith et al.[8] would not be changed if the EF cutoff was >50% instead of >40%. Therefore, it is reasonable to conclude that the ideal cutoff to differentiate Reduced EF from Preserved EF is 50%.

We performed a study to analyze the clinical and echo profile in HF with Preserved Ejection Fraction among patients admitted for HF in our Hospital over a period of one year to assess the relative proportions of Normal Versus Reduced EF.

Aims & Objectives

AIM AND OBJECTIVES

1. To study about the clinical Features of patients with Heart Failure with Preserved Ejection Fraction.

2. To study about the Echocardiographic features of Heart Failure with Preserved Ejection Fraction.

Review of Literature

REVIEW OF LITERATURE

3.1 DEFINITIONS :

1. Heart Failure: A pathophysiological state in which abnormality of cardiac function is responsible for the failure of the heart to pump blood at a rate commensurate with requirements of the metabolizing tissues[1].

2. Ejection fraction: By definition, the volume of blood within a ventricle immediately before a contraction is known as the end-diastolic volume. Similarly, the volume of blood left in a ventricle at the end of contraction is end-systolic volume. The difference between end-diastolic and end-systolic volumes is the stroke volume, the volume of blood ejected with each beat. Ejection fraction (EF) is the fraction of the end-diastolic volume that is ejected with each beat; that is, it is stroke volume (SV) divided by end-diastolic volume (EDV):

$$EF = \frac{SV}{EDV} = \frac{EDV - ESV}{EDV}$$

1.HFNEF: Symptoms and signs of Heart Failure with Left Ventricular Ejection Fraction ≥50% by Echocardiography[4].

3.2 EPIDEMIOLOGY:

Epidemiological studies have defined the prevalence of HF with Preserved EF in various HF populations and have documented a prevalence of 50% to 55%.

The prevalence of HFnlEF among patients with HF varies dramatically with Age and Gender. Much more common in women than in men at any age in contrast to HF with Depressed EF which is common in men than in women. Most contemporary studies have been suggested that Mortality of HF with Normal Ejection Fraction is similar to that of HF with reduced Ejection Fraction. Difference in survival between two categories of HF is minimal. Although survival has improved over time for patients with HF with a reduced EF but it has not changed for patients with HFnlEF [(1)].

3.3 CLINICAL FEATURES:

HFnlEF were shown to have similar Pathophysiological characteristics compared with patients with a Reduced EF.

Framingham criteria for diagnosis of Heart Failure:

TABLE NO- 1

Clinical Features of Heart Failure with Normal Ejection Fraction[1]

Parameter	Features
Framingham criteria for diagnosis of heart failure[*]	
Major criteria	Paroxysmal nocturnal dyspnea or orthopnea
	Jugular venous distention (or CVP > 16 mm Hg)
	Rales or acute pulmonary edema
	Cardiomegaly
	Hepatojugular reflex
	Response to diuretic (weight loss >4.5 kg in 5 days)
Minor criteria	Ankle edema
	Nocturnal cough
	Exertional dyspnea
	Pleural effusion
	Vital capacity < two thirds of normal
	Hepatomegaly
	Tachycardia (>120 bpm)
Demographic features	Elderly; female > male
Underlying CV disease	Hypertension, coronary disease, diabetes, atrial fibrillation
Comorbidities	Obesity, renal dysfunction
Doppler echocardiography results	
LV size	Normal to ↓ (small subset with↑)
LV mass	LVH common but *frequently* absent; ↑ relative wall thickness (> 0.45)
Left atrium	Enlarged
Diastolic	Grade I-IV (∞ diastolic dysfunction severity, BP,

Parameter	Features
dysfunction	volume status)
Other features	PH, wall motion abnormality, RV enlargement
Pertinent negatives	Rule out valve disease, pericardial disease, ASD
BNP or NT-proBNP	↑ but HFnlEF < HFrEF
Exercise testing	↓ VO_2 peak
	Exaggerated hypertensive response in many
	Chronotropic incompetence in subset
Chest radiogram	Similar to HFrEF, cardiomegaly, pulmonary venous hypertension, edema, pleural effusion
Electrocardiogram	Variable
* Two major or one major and two minor criteria	

None of the clinical features can be used to distinguish patients with HFnlEF reliably from those with HF with reduced EF. Thus assessment of EF with cardiac imaging is needed to distinguish HFnlEF with a reduced EF.

3.4.AETIOLOGY:

1. **Aging:** Structural cardiac changes with aging (e.g., increased cardiomyocyte size, increased apoptosis with decreased myocyte number, altered growth factor regulation, focal collagen deposition) and functional changes at the cellular level involving blunted beta-adrenergic responsiveness, excitation-contraction coupling, and altered calcium-handling proteins may contribute to diastolic dysfunction with normal aging.

2. **Female Gender:** The female predominance in HFnlEF are not entirely clear, but women have higher vascular and LV systolic and diastolic stiffness than men, and vascular and ventricular stiffness increases more dramatically with age in women [9].

3. **Hypertension (HT):** Chronically increased blood pressure is an important stimulus for cardiac structural remodeling and functional changes. The resultant hypertensive heart disease is characterized by LV hypertrophy (LVH), increasing vascular and ventricular systolic stiffness, impaired relaxation, and increased diastolic stiffness, all factors linked to the pathogenesis of HFnlEF[10].

4. **Coronary Artery Disease (CAD):** Acute and chronic Ischemia is known to cause Diastolic dysfunction and is the leading cause of HF in both Reduced and Normal EF [5].

5. **Atrial Fibrillation: M**ay cause decompensated HF in patients with diastolic dysfunction and diastolic dysfunction (in the absence of HF) is also a risk factor for atrial fibrillation. Thus, diastolic dysfunction, atrial fibrillation, and HFnlEF are common and related conditions that probably share common pathogenic mechanisms in the elderly.

6. **Obesity:** Increased adiposity imposes an adverse hemodynamic load on the heart and also a source of a large number of biologically

active peptide and nonpeptide mediators, many linked to chronic inflammation by various pathways. Increased body mass index (BMI) is a risk factor for hypertension, diabetes mellitus, coronary artery disease, and atrial fibrillation, all of which are associated with HFnlEF.

7. **Diabetes Mellitus:** The morphological changes in the diabetic heart include myocyte hypertrophy, increased extracellular matrix (fibrosis), and intramyocardial microangiopathy. Functional changes, which may represent a continuum, include endothelial-dependent and endothelial-independent microvascular dysfunction, impaired relaxation, and increased passive diastolic stiffness and contractile dysfunction. Mechanisms contributing to structural and functional coronary vascular and myocardial changes are diverse and include metabolic disturbances, activation of proinflammatory and profibrotic mediators, cardiac autonomic neuropathy, and increases in advanced glycation end-products (AGE), which promote increased collagen accumulation and increased collagen stiffness. AGE accumulation may also play a role in age-related cardiovascular stiffening.

8. **Renal Failure:** Bilateral renal artery stenosis with rapid-onset or flash pulmonary edema is a well-recognized cause of HFnlEF.

9. **Cardiomyopathy-HOCM** (Hypertrophic Obstructive Cardiomyopathy), Infiltrative Cardiomyopathies(Amyloidosis), Idiopathic Restrictive Cardiomyopathy.

10. **Constrictive Pericarditis.**

11. **Radiation Heart Disease.**

12. **Anemia, Thyrotoxicosis[14], Obstructive sleep Apnea[13].**

13. **Excessive use of Salty foods, Non-steriodal Anti-inflammatory drugs, Thiazolidinediones etc.[13]**

3.5 PATHOPHYSIOLOGY:

Understanding Pathophysiological mechanism in HFnlEF mandates a clear understanding of LV diastolic and systolic function.

3.51 CARDIAC CYCLE:

The period from the beginning of one heart beat to the beginning of the next is called the cardiac cycle. Each cycle is initiated by spontaneous generation of an action potential in the sinus node. The action potential travels rapidly through both atria and then through the A-V bundle into the ventricles. However, because of a special arrangement of the conducting system from the atria into ventricles, there is a delay of more than 1/10 second between passage of the cardiac

impulse from the atria into the ventricles. This allows the atria to contract ahead of the ventricles, thereby, pumping blood into the ventricles prior to the very strong ventricular contraction. Thus, the atria act as primer pumps for the ventricles, and the ventricles then provide the major source of power for moving blood through the vascular system[17].

The cardiac cycle consists of a period of relaxation called diastole, during which the heart fills with blood followed by a period of contraction called systole.

Blood normally flows continually from the great veins into the atria; approximately 75 percent of blood flows directly through the atria into the ventricles even before the atria contract, then atrial contraction usually causes an additional 25 percent filling of the ventricles.

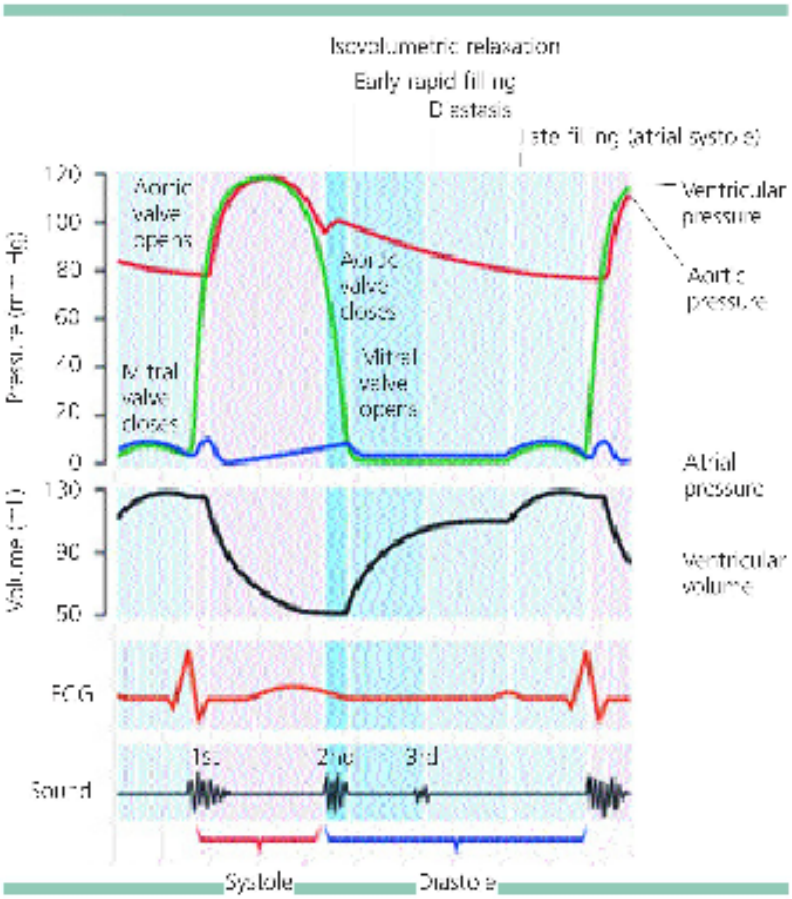


FIGURE 1. Cardiac cycle, showing changes in left atrial pressure, left ventricular pressure, aortic pressure, and ventricular volume; the electrocardiogram (ECG);

Therefore, the atria simply function as primer pumps that increase the ventricular pumping effectiveness as much as 25 percent. Yet, the heart can continue to operate quite satisfactorily under normal resting conditions even without this extra 25 percent effectiveness because it normally has the capability of pumping 300 to 400 percent more blood than is required by the body anyway. Therefore, when the atria fail to function, the difference is unlikely to be noticed unless a person exercises; then acute signs of heart failure occasionally develop, especially shortness of breath.

Function of the Ventricles:

During ventricular systole, large amounts of blood accumulate in the atria because of the closed A-V valves. Therefore, just as soon as systole is over and the ventricular pressures fall again to their low diastolic values, the high pressures in the atria immediately push the A-V valves open and allow the blood to flow rapidly into the ventricles.

3.511 PHYSIOLOGY OF SYSTOLE:

Period of Isovolumic (isometric) contraction:

Immediately after ventricular contraction begins, the ventricular pressure abruptly rises causing the A-V valves to close. Then an additional 0.02 to 0.03 second is required for the ventricle to build up sufficient pressure to push the semilunar (aortic and pulmonary) valves open against the pressures in the aorta and pulmonary artery. Therefore, during this period of time, contraction is occuring in the ventricles, but there is no emptying. This period is called the period of isovolumic or isometric contraction, meaning by these terms that tension is increasing in the muscle, but no shortening of the muscle fibres is occuring.

Period of ejection:

When the left ventricular pressure rises slightly above 80 mm Hg (and the right ventricular pressure slightly above 80 mm Hg), the ventricular pressure now push the semilunar valves open, Immediately , blood begins to pour out of the ventricle, with about 70 per cent of the emptying occuring during the first third of the period of ejection and the remaining 30 percent during the next two thirds. Therefore, the first third is called the period of rapid ejection and the last two thirds the period of slow ejection. For a very peculiar reason, the ventricular pressure falls to value slightly below that in the aorta during the period of slow ejection, despite the fact that some blood is still leaving the left ventricle. The reason is that the blood flowing out of the ventricle has built up momentum. As this momentum decrease during the latter part of systole, the kinetic energy of the momentum is converted into pressure in the aorta, which makes the arterial pressure slightly greater than the pressure inside the ventricles.

Period of Isovolumic (Isometric) Relaxation:

At the end of systole, ventricular relaxation begins suddenly, allowing the Intraventricular pressure to fall rapidly. The elevated pressures the distended large arteries immediately push blood back toward the ventricles, which snaps the aortic and pulmonary valves

closed. For another 0.03 to 0.06 second, the ventricular muscle continues to relax, even though the ventricular volume does not change, giving rise to the period of Isovolumic or isometric relaxation. During this period, the Intraventricular pressure fall rapidly back to their low diastolic levels. Then the A-V valves open to begin a new cycle of ventricular pumping.

End- Diastolic volume, End- systolic and stroke volume output:

During diastole, filling of the ventricles normally increase the volume of each ventricle to about 100 to 120 milliliters (ml). This volume is known as the end- diastolic volume. Then as the ventricles empty during systole, the volume decrease by about 70 ml, which is called the stroke volume output. The remaining volume in each ventricle, about 40 to 50 ml, is called the end-systolic volume. The fraction of the end- diastolic volume that is ejected is called the ejection fraction- usually equal to about 60 percent. The cardiac cycle which is divided into two periods, viz., systole and diastole, can be further subdivided into phases of cardiac-activity as described.

The first phase of ventricular systole is Isovolumic (isovolumetric or isochoric) contraction. This phase begins with the first detectable rise in left ventricular pressure, it is associated with the initial, mitral component (MC) of the first heart sound. The end of the Isovolumic

contraction phase and the beginning of the succeeding rapid ventricular ejection phase are indicated by the opening of the aortic valve (AO), a rise in aortic pressure, a decrease in ventricular volume. The onset and termination of the next phase of reduced ventricular ejection are less well defined. This normally occurs prior to the peak systolic pressure in the left ventricle and aorta. The phase of reduced ejection lasts until the end of actual ejection and the beginning of diastole. The very brief initial phase of diastole is referred to as protodiastole and represents the time required for the reversal of flow in the aorta and for closure of the aortic valve. The beginning of the next phase of isovolumic relaxation of the left ventricle is signified by the closure of the aortic valve, as indicated by the second heart sound. Isovolumic relaxation lasts until the left ventricular pressure falls below the left atrial pressure and blood begins to flow from the atrium into the ventricle. Both isovolumic relaxation and the following phase of rapid ventricular filling are produced by elastic record and active relaxation of the ventricular myocardium.

The end of the isovolumic relaxation phase and the beginning of the rapid ventricular filling are indicated by an increase in the ventricular volume curve, which coincides with the opening of the mitral valve.

3.512 PHYSIOLOGY OF DIASTOLE:

We operationally define diastole as the phase of the cardiac cycle that starts with the onset of isovolumic relaxation and ends with the cessation of inflow, because factors that determine left ventricular filling are operative at this time period. It is thus clear that both the active and passive properties of the ventricle must be included in our discussion of the determinants of filling, because both contribute to the phasic atrioventricular pressure gradient. Conceptually, it has been suggested that systole defines one entire contraction - relaxation cycle, thus restricting diastole to that phase of cardiac cycle separating two contraction- relaxation cycles, i.e., diastasis and atrial systole.

Events in normal diastole:

The clinical definition of left ventricular diastole describes the time period between aortic and mitral valve closure, and can be subdivided into four interrelated events:

a) The Isovolumic relaxation period: Which extends from aortic valve closure to mitral opening. Left ventricular pressure declines rapidly without any ventricular filling, and, by definition no change in left ventricular volume occurs. The duration of this period increases with age, but is in the range of 60-90 ms.

b) The early or rapid filling period: Which follows mitral valve opening and where the ventricle fills abruptly as a consequence of the positive pressure difference between left atrium and left ventricle; and the effect of ventricular suction (demonstrated by the left ventricular pressure continuing to fall immediately after mitral valve opening). In young normal subjects at rest 75% of ventricular filling occurs during this period, which has a duration of approximately 200ms. (Also called as protodiastolic period).

c) Diastasis: Where the atrial ventricular equalize, but filling may continue due to the momentum of blood during the proceeding rapid filling phase. The duration of this period depends on heart rate and almost disappear at times of tachycardia. Approximately 5% of left ventricular filling occur during this phase.

d) Atrial systole: (Late rapid filling phase) Which finishes with mitral valve closure, accounts for about 20% of ventricular filling in young normal subjects, although with increasing age greater filling occurs in this period. This is also known as atrial kick or atrial booster.

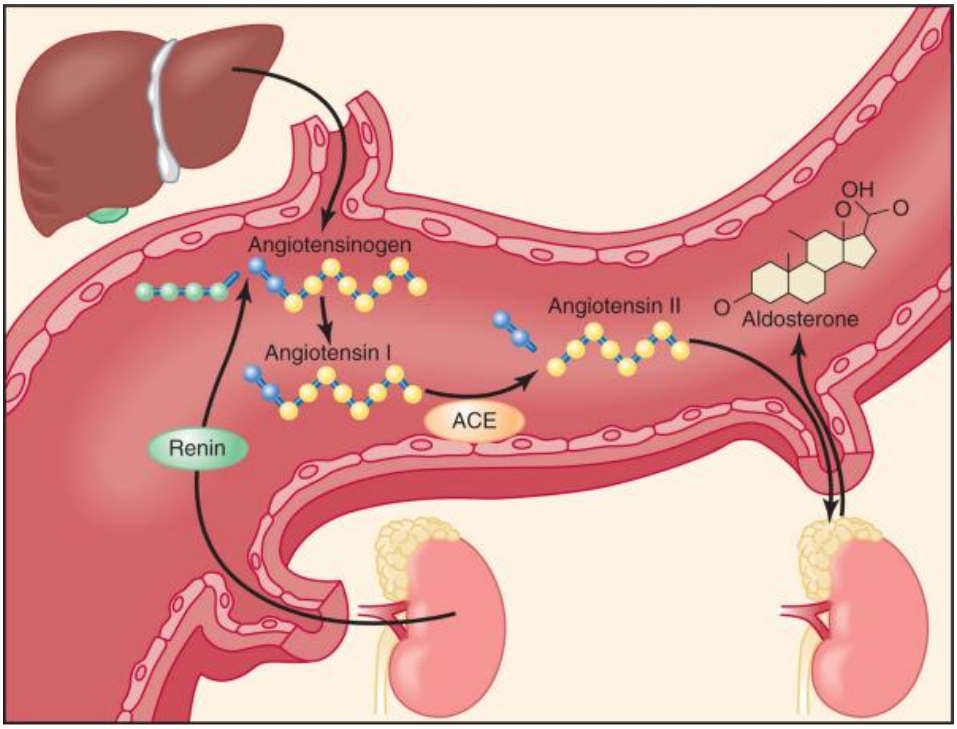
3.6 MYOCARDIAL SYSTOLIC DYSFUNCTION AND HEART FAILURE:

The primary abnormality in non valvular heart failure is impairment in the left ventricular function, leading to a fall in cardiac output. The fall in cardiac output leads to activation of several neurohormonal compensatory mechanisms aimed at improving the mechanical environment of the heart. Activation of the sympathetic system, for example tries to maintain cardiac output with an increase in heart rate, increased myocardial contractility and peripheral vasoconstriction (Increased catecholamines). Activation of Renin angiotensin aldosterone system also results in vasoconstriction and increase in blood volume, with retention of salt and water. Concentration of vasopressin and natriuretic peptides increase.

RAAS :

Stimulation of the RAAS leads to increased concentration of renin, angiotension II and aldosterone. Angiotension II is a potent vasoconstrictor of the renal and systemic circulation where it stimulates release of noradrenaline from sympathetic nerve terminals which inhibits vagal tone and promotes the release of aldosterone. This leads to the retention of sodium and water. In addition, angiotension II has an

important effects on cardiac myocytes and may contribute to the endothelial dysfunction that is observed in chronic heart failure.



Fig(2) Renin-angiotensin-aldosterone System(RAAS)

Sympathetic nervous system:

The sympathetic nervous system is activated in heart failure via low and high pressure baroreceptors, as an early compensatory mechanism which provides Activation of sympathetic nervous system inotropic support and maintains cardiac output. In the long term, the ability of the myocardium to respond to chronic high concentration of catecholamines is attenuated by a down regulation in beta receptors. This may be associated with baroreceptor dysfunction and a further increase in sympathetic activity.

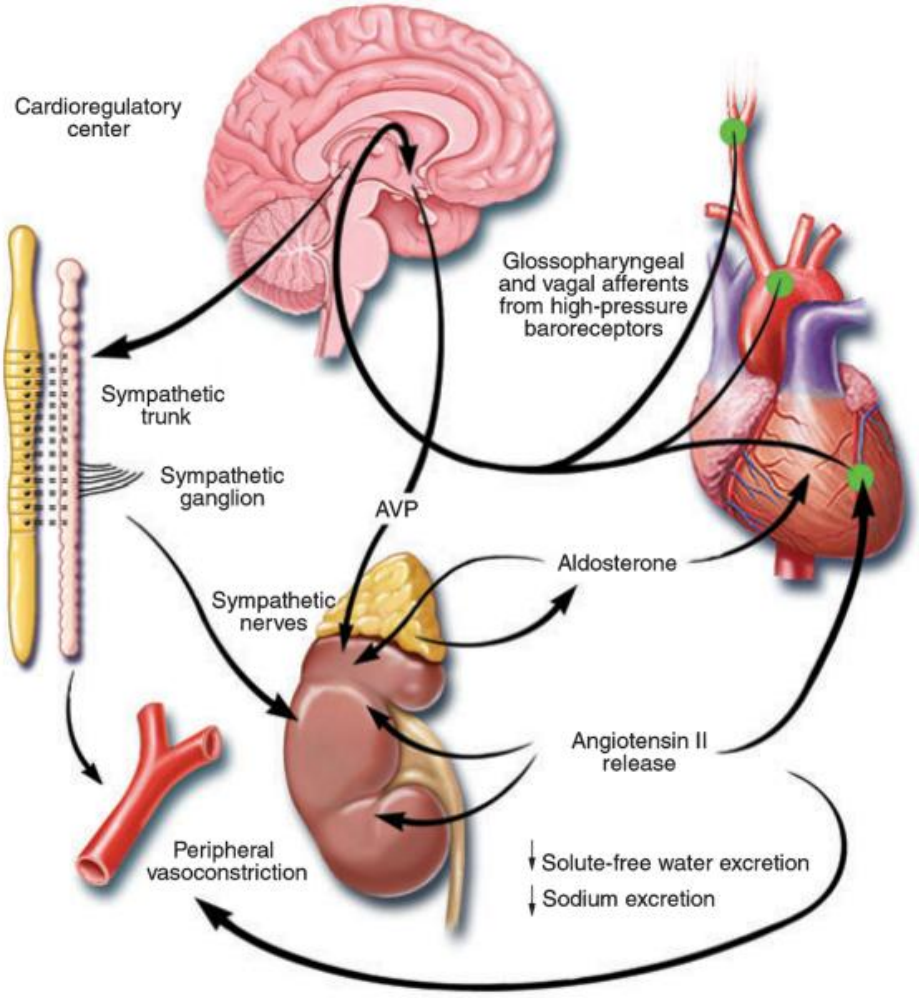


Figure (3)Neurohumoral Response in Heart Failure

Natriuretic peptide[37]:

There are 3 natriuretic peptides of similar structure and these exert a wide range of effects on the heart, kidneys and central nervous system. Atrial natriuretic peptides is released from the atria in response to stretch, leading to natriuresis and vasodilatation. In humans, brain natriuretic peptide (BNP) is also released from the heart (mainly from the ventricles) and its actions are similar to those of ANP. C-type natriuretic peptide is limited to the vascular endothelium and central nervous system and has only limited effects on natriuresis and vasodilatation.BNP and NT Pro BNP values on average lower in HFnlEF as compared with HF with reduced EF.

Vasopressin[1]:

Vasopressin concentration is also increased in severe chronic heart failure. High concentrations of the hormone are particularly common in patients receiving diuretic treatment and this may contribute to the development of hyponatremia.

Endothelin[1]:

Endothelin is secreted by vascular endothelial cells,and cardiac myocytes and is a potent vasoonstrictor on the renal vasculature, promoting the retention of sodium and water .

3.7 MYOCARDIAL DYSFUNCTION DUE TO REMODELING, HIBERNATION AND STUNNING:

After extensive myocardial infarction, cardiac contractility is frequently impaired and neurohormonal activation leads to regional eccentric and concentric hypertrophy of Non-infarcted segment with expansion of infarct zone. This is known as Ventricular Remodeling.

Particular risk factors for this development of progressive ventricular dilatation after an MI include large infarcts, anterior infarctions, occlusion of artery related to infarction and hypertension. Myocardial dysfunction may also occur in response to stunning which describes delayed recovery of myocardial function despite restoration of coronary blood flow in the absence of irreversible damage. This is in contrast to hibernating myocardium which describes persistent myocardial dysfunction due to reduced perfusion although cardiac myocytes remain viable and myocardial contraction may improve with revascularization.

Asymptomatic LV Systolic Dysfunction:

Plasma norepinephrine concentrations increase early in the development of left ventricular dysfunction and plasma renin activity usually increases in patients receiving diuretic treatment. Norepinephrine concentration in asymptomatic LV dysfunction is a strong and

independent predictor of the development of symptomatic heart failure and long term mortality. In severe untreated chronic heart failure, concentrations of renin, angiotension II, aldosterone, noradrenaline and ANP are all increased. Plasma concentrations of various neuroendocrine markers correlate with both the severity of heart failure and the long term prognosis. Patients with chronic heart failure and raised plasma noradrenaline concentrations do also have a worse prognosis.

3.8 DIASTOLIC DYSFUNCTION AND HEART FAILURE:

3.81 Definition of DD:

Conceptually, diastole encompasses the time period during which the myocardium loses its ability to generate force and shorten and returns to an unstressed length and force. By extension, DD occurs when these processes are prolonged, slowed, or incomplete. The measurements that reflect changes in this normal function generally depend on the onset, rate, and extent of ventricular pressure decline and filling and the relationship between pressure and volume or stress and strain during diastole. Moreover, if diastolic function is truly normal, these measurements must remain normal both at rest and during the stress of a variable heart rate, stroke volume, end-diastolic volume, and blood pressure[11].

3.82 Mechanisms That Cause DD:

Conceptually, the mechanisms that cause abnormalities in diastolic function that lead to the development of diastolic heart failure can be divided into factors intrinsic to the myocardium itself (myocardial) and factors that are extrinsic to the myocardium (extramyocardial; Table 2). Myocardial factors can be divided into structures and processes within the cardiac muscle cell (cardiomyocyte), within the extracellular matrix (ECM) that surrounds the cardiac muscle cell, and that activate the autocrine or paracrine production of neurohormones. Each of these mechanisms are active in the major pathological processes that result in DD and heart failure. Myocardial and extramyocardial mechanisms, cellular and extracellular mechanisms, and neurohumoral activation each play a role in the development of diastolic heart failure caused by ischemia, pressure-overload hypertrophy, and restrictive and hypertrophic cardiomyopathy[12]

TABLE NO-2

Diastolic Heart Failure: Mechanisms[12]

Extramyocardial

Hemodynamic load: early diastolic load, afterload

Heterogeneity

Pericardium

Myocardial

Cardiomyocyte

Calcium homeostasis

Calcium concentration

Sarcolemmal and SR calcium transport function

Modifying proteins (phospholamban, calmodulin, calsequestran)

Myofilaments

Tn-C calcium binding

Tn-I phosphorylation

Myofilament calcium sensitivity

α/ß-myosin heavy chain ATPase ratio

Energetics

ADP/ATP ratio

ADP and Pi concentration

Cytoskeleton

Microtubules

Intermediate filaments (desmin)

Microfilaments (actin)

Endosarcomeric skeleton (titin, nebulin)

Extracellular matrix

Fibrillar collagen

Basement membrane proteins

Proteoglycans

MMP/TIMP

Neurohormonal activation

Renin-angiotensin-aldosterone

Sympathetic nervous system

Endothelin

Nitric oxide

Natriuretic peptides

MMP indicates matrix metalloproteinase; TIMP, tissue inhibitor of matrix metalloproteinase.

Cardiomyocyte:

DD can be caused by mechanisms that are intrinsic to the cardiac muscle cells themselves. These include changes in calcium homeostasis caused by

1. Abnormalities in the sarcolemmal channels responsible for short- and long-term extrusion of calcium from the cytosol, such as the sodium calcium exchanger and the calcium pump.

2. Abnormal sarcoplasmic reticulum calcium (SR Ca2+) reuptake caused by a decrease

3. in SR Ca2+ ATPase and Changes in the phosphorylation state of the proteins that modify SR Ca2+ ATPase function, such as phospholamban, calmodulin, and calsequestrin. Changes in any of these processes can result in increased cytosolic diastolic calcium concentration, prolongation in the calcium transient, and delayed and slowed diastolic decline in cytosolic calcium concentration. These changes have been shown to occur in cardiac disease and cause abnormalities in both active relaxation and passive stiffness[12].

The myofilament contractile proteins consist of thick-filament myosin and thinfilament actin proteins. Bound to actin are a complex of regulatory proteins that include tropomyosin and troponin (Tn) T, C, and I. During relaxation, ATP hydrolysis is required for myosin detachment from actin, calcium dissociation from Tn-C, and active sequestration of calcium by the SR. Modification of any of these steps, the myofilament proteins involved in these steps, or the ATPase that catalyzes them can alter diastolic function[12]. Thus, relaxation is an energy-consuming process. Energetic factors necessary to maintain normal diastolic function include the requirement that the concentration of the products of ATP hydrolysis (ADP and inorganic phosphate [Pi]) must remain low and produce the appropriate relative ADP/ATP ratio. DD will occur if the absolute concentration of ADP or Pi increases or if the relative ratio of ADP/ATP rises. Abnormalities in these energetics factors may be caused by a limited ability to recycle ADP to ATP because of a decrease in phosphocreatine.

The cardiomyocyte cytoskeleton is composed of microtubules, intermediate filaments (desmin), microfilaments (actin), and endosarcomeric proteins (titin, nebulin, - actinin, myomesin, and M-protein). Changes in some of these cytoskeletal proteins have been shown to alter diastolic function.[1] Changes in titin isotypes have been shown to

alter relaxation and viscoelastic stiffness. During contraction, potential energy is gained when titin is compressed, and during diastole, titin acts like viscoelastic springs, expends this stored potential energy, and provides a recoiling force to restore the myocardium to its resting length. In addition, titin extension during diastole is limited and protects the myocardium from being stretched too far beyond resting length. In experimental endstage dilated cardiomyopathy, titin isoforms and distribution have been shown to change in a manner that confers an increase in stiffness. Likewise, an increase in microtubule density and distribution has been shown in some forms of pressure overload to act as a viscous load and increase myocardial and cardiomyocyte viscoelastic stiffness. This change in diastolic function is reversible when microtubules are acutely depolymerized by chemical or physical agents.

Extracellular Matrix:

Changes in the structures within the ECM can also affect diastolic function. The myocardial ECM is composed of 3 important constituents: (1) fibrillar protein, such as collagen type I, collagen type III, and elastin; (2) proteoglycans; and (3) basement membrane proteins, such as collagen type IV, laminin, and fibronectin. It has been hypothesized that the most important component within the ECM that contributes to the development of diastolic heart failure is fibrillar collagen. The evidence

that suggests that changes in ECM fibrillar collagen play an important role in the development of DD and diastolic heart failure follows 3 lines. First, disease processes that alter diastolic function also alter ECM fibrillar collagen, particularly in terms of its amount, geometry, distribution, degree of cross-linking, and ratio of collagen type I versus collagen type III. Second, treatment of these disease processes, which is successful in correcting diastolic function, is associated with normalization of fibrillar collagen. Third, experiments in which a chronic alteration in collagen metabolism is accomplished result in an alteration of diastolic function. The role played by other fibrillar proteins, the basement membrane proteins, and the proteoglycans remains largely unexplored.

The regulatory control of collagen biosynthesis and degradation has at least 3 major determinants: transcriptional regulation by physical, neurohumoral, and growth factors; posttranslational regulation, including collagen cross-linking; and enzymatic degradation. Collagen synthesis is altered by load, including preload and afterload; neurohumoral activation, including the renin-angiotensin-aldosterone system (RAAS) and sympathetic nervous system; and growth factors. Collagen degradation is under the control of proteolytic enzymes, which includes a family of zinc-dependent enzymes, the matrix metalloproteinases (MMPs).The

balance between synthesis and degradation results in the total collagen present in a given pathological state at a specific time. Changes in either synthesis or degradation and their regulatory processes have been shown to alter diastolic function and lead to the development of diastolic heart failure.

Neurohumoral and Cardiac Endothelial Activation:

Both acutely and chronically, neurohumoral and cardiac endothelial activation and/or inhibition have been shown to alter diastolic function. Chronic activation of the RAAS has been shown to increase ECM fibrillar collagen and to be associated with increased stiffness. Inhibition of RAAS prevents or reverses this increase in fibrillar collagen and generally but not consistently reduces myocardial stiffness. In addition, acute activation or inhibition of neurohumoral and cardiac endothelial systems has been shown to alter relaxation and stiffness.

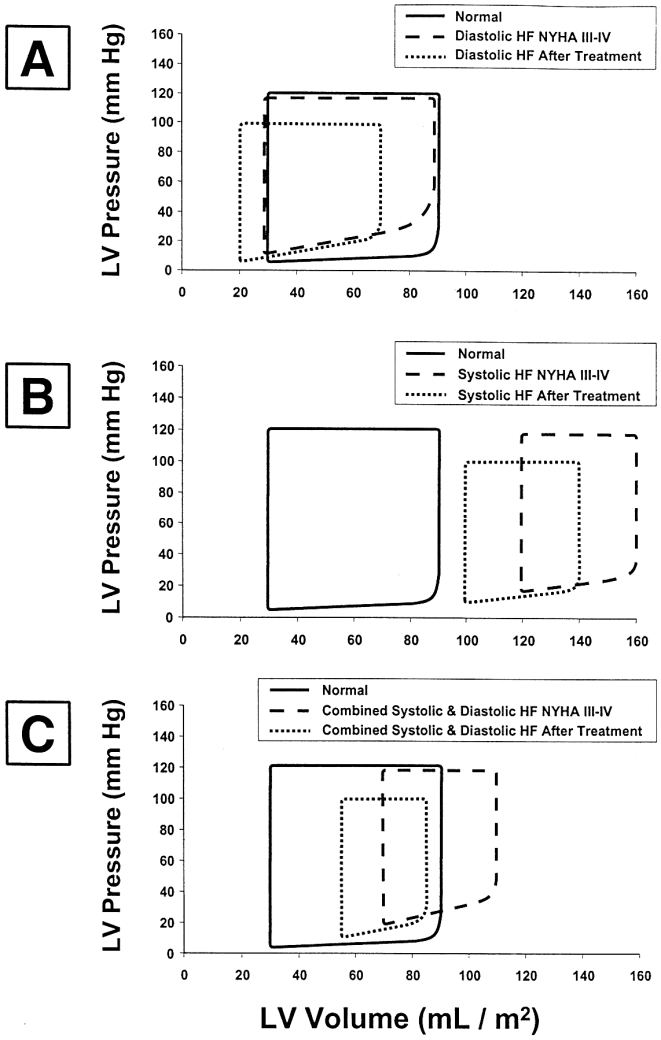


Figure (4) Pressure-volume loops contrasting isolated diastolic heart failure (A) with systolic heart failure (B) and combined systolic and diastolic heart failure (C). A normal patient (solid line) is compared with a patient with heart failure before (dashed line) and after (dotted line) treatment. HF indicates heart failure[11].

These acute pharmacological interventions act in a time frame too short to alter the ECM; therefore, their effect on diastolic function must

be caused by direct action on the cardiomyocyte to alter 1 or more cellular determinants of diastolic function. For example, acute treatment of patients with pressure overload with an ACE inhibitor, a direct NO donor, or an indirect endothelin-dependent NO donor caused left ventricular (LV) pressure decline and LV filling to be more rapid and complete and caused the LV pressure-versus-volume relationship to shift to the right, decreasing stiffness. In addition, there is a cyclical release of NO in the heart that is most marked subendocardially and that peaks at the time of relaxation and filling. These brief bursts of NO release provide a beat-to-beat modulation of relaxation and stiffness.

3.9 ECHOCARDIOGRAPHY

Echocardiography has come a long way since its invention by Dr. Edler and Hertz from Sweden in the early 1950s. Today it is recognized as one of the most important diagnostic techniques available in cardiovascular medicine.

3.91 TYPE OF ECHOCARDIOGRAM

1. **M-Mode:** This provides an unidimensional time motion image of the cardiac structures with great sensitivity. The M-mode tracing is also called. Ice-pick View, M-stands for motion.

2. **Two-dimensional:** This provides a two dimensional image of the cardiac structures. It can be static or real time.

3. **Doppler echocardiography:** M-Mode and two-dimensional echocardiography essentially create ultrasonic images of the heart Doppler echocardiography utilizes to record blood flow within the cardiovascular system.

3.92.ASSESSMENT OF DIASTOLIC FUNCTION USING DOPPLER[16]:

Doppler flow pattern in the left ventricular inflow tract just beyond the mitral valve superficially resembles an M-mode tracing of the anterior mitral leaflet. There is rapid inflow in the early diastole, decreased flow in the mid diastole and subsequent increase in inflow with atrial systole. Doppler echocardiography has been used to evaluate left ventricular diastolic function. M-mode technique has been used to record the rate of relaxation of the left ventricular cavity.

IRT (Isovolumetric relaxation time) can be measured by two ways

1) M-Mode Echocardiography,

2) Similar interval may be measured by combining Doppler echocardiography and phonocardiogram. We use this technique to measure IRT.

This phenomena has been quantitated in several ways. The simple technique is to take a ratio of the peak velocity with early filling or E point and the peak velocity with atrial filling or A point. Normally the velocity at the E point is significantly higher than that at the A point. With reduced early left ventricular filling this ratio is reversed(Grade-1 DD). With restrictive ventricular filling the diastolic velocities may again reverse with a tall E-wave and reduced A-wave. This is called as Pseudonormalisation(Grade-2 DD). Pseudonormalisation is also seen in patient with more severe impairment of diastolic performance than the pattern of delayed relaxation. Restrictive filling (Grade-3 DD) which is reversible to Grade-2 with valsalva manoeuvre. Grade-4 DD which is restrictive filling and irreversible to Grade-2 with valsalva manoeuvre[15].

Transmitral inflow (E/A; E wave deceleration): The E wave occurs related to LV `suction' and LA pressure - the E wave acceleration will be higher with high LA pressure, and lowered with impaired LV relaxation. Deceleration of inflow of the E wave is measured by deceleration time (DT), which shortens with decreasing LV compliance. DT is rather complex, as higher LA pressures shorten it. A normal DT is about

200±32ms; values over 240ms indicate impaired relaxation, and under 150ms suggest restriction.

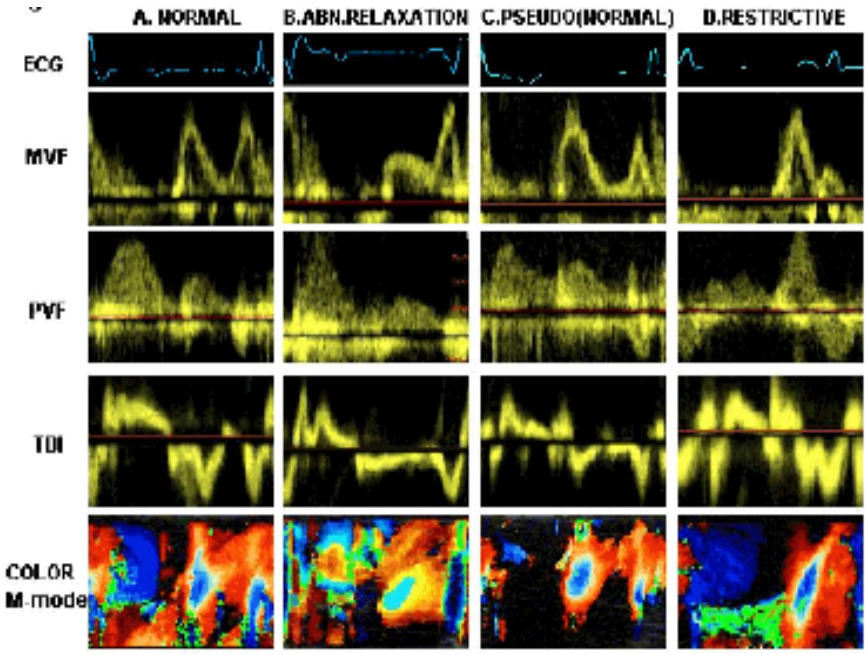


Fig (5): Recordings are obtained from a normal individual and patients with diastolic dysfunction. A) Normal individual - 70 years old (6.581.360); B) Abnormal relaxation in a 55- year -old man with LVH (on hemodialysis); C) a 44 -year old man with LV hypertrophy and D) a 41-year -old man with end-stage heart failure[16].

Pulmonary venous inflow (atrial flow reversal): Pulmonary vein Doppler is easily imaged using TOE, but may even be performed on TTE using a foreshortened apical cross-section. The normal pattern is to see a systolic (S) wave, a diastolic (D) wave, with perhaps some retrograde

flow during atrial contraction. The last wave is sometimes called the A_R wave - it normally has an amplitude of under 25cm/s, and a shorter duration than the transmitral A wave. Velocity and duration of A_R increase with worsening diastolic dysfunction.

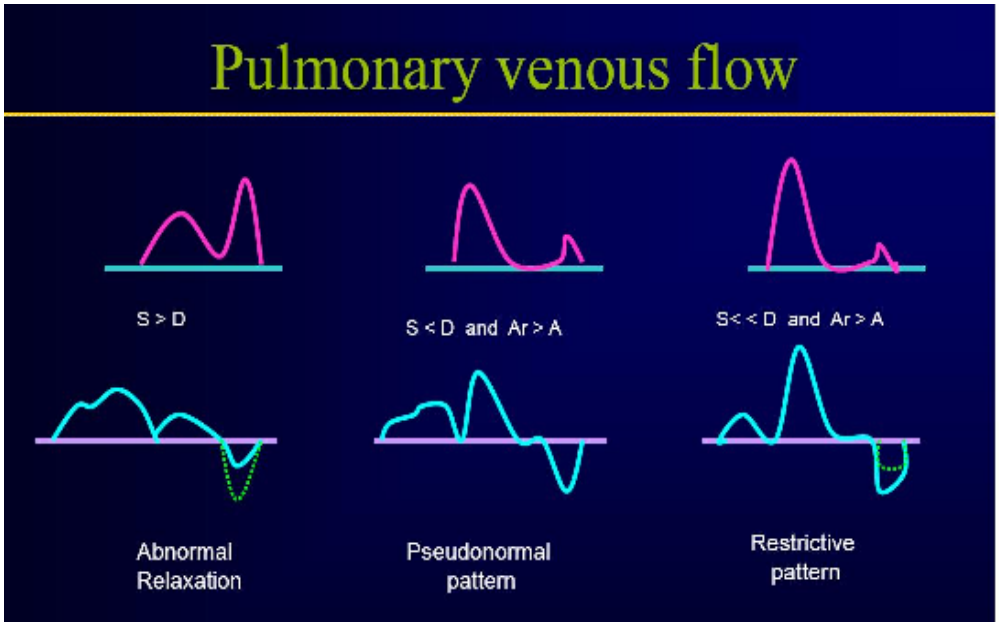


Fig (6): Pulmonary Venous flow in Restrictive filling

Tissue Doppler imaging (TDI): LVD can be more soundly established by Tissue Doppler imaging (TDI) and invasively by Cardiac Catheterization. TDI yield E/E' ratio Greater than 15 then additional echovariables like Doppler flow profile of mitral valve or pulmonary veins and measurement of LV mass index or Left atrial volume index can be assessed. If Cardiac Catheterization shows LV diastolic pressure Greater than 16mmHg or mean Pulmonary capillary wedge pressure Greater than 12mmHg. Echo Doppler techniques using LV filling

pressure and TDI of mitral annulus help in identifying and classifying degree of LV diastolic dysfunction[13], [40].

3.10 TREATMENT OF HEART FAILURE WITH PRESERVED EJECTION FRACTION:

General Approach[12]:

The guidelines for the management of diastolic heart failure are based on clinical investigations in relatively small groups of patients, clinical experience, and concepts based on pathophysiological mechanisms.

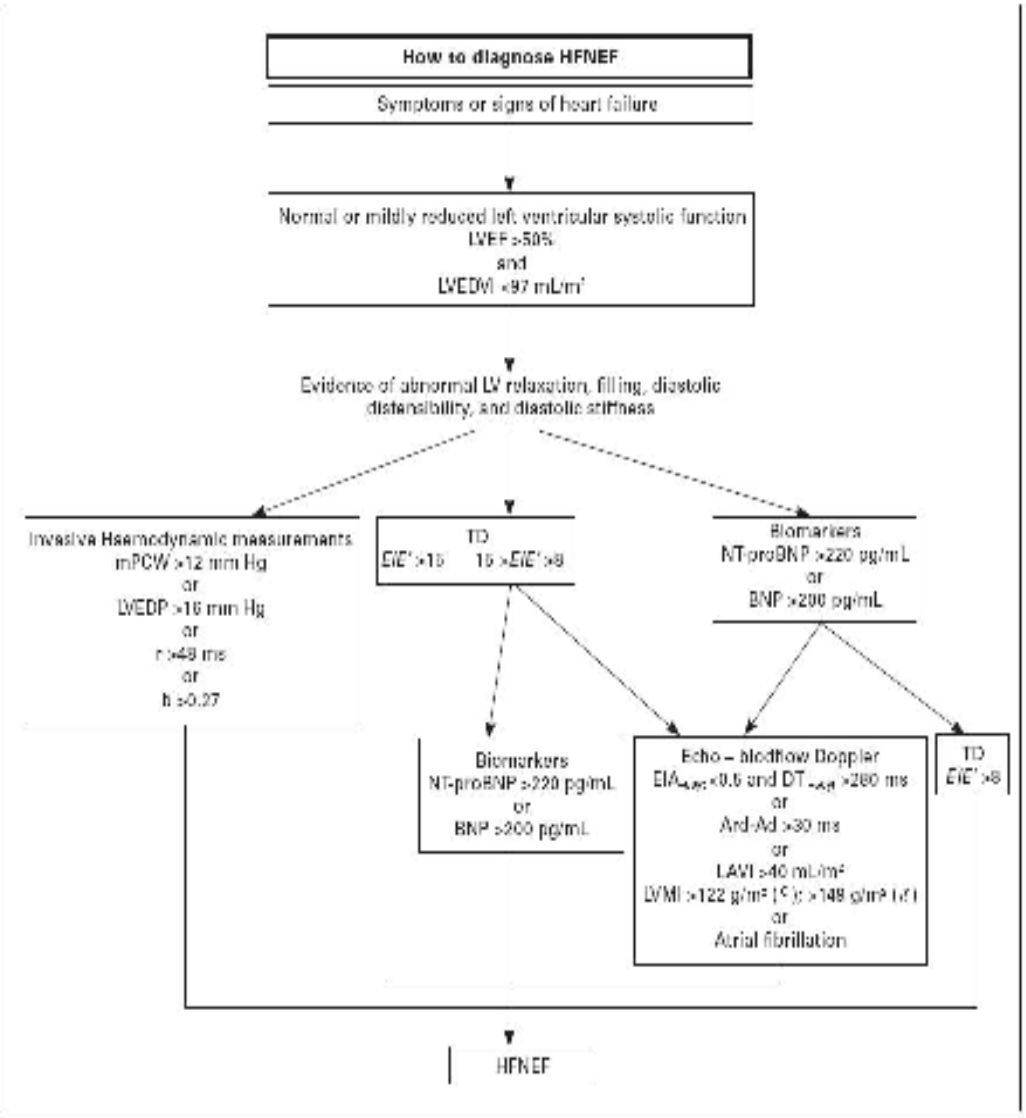
Treatment of diastolic heart failure can be framed in 3 steps.

First, treatment should target symptom reduction, principally by decreasing pulmonary venous pressure at rest and during exertion. Both nonpharmacological and pharmacological approaches proposed but not proven to be effective in targeting symptoms are listed in Table 3.

Second, treatment should target the pathological disease that caused the diastolic heart failure. For example, coronary artery disease, hypertensive heart disease, and aortic stenosis provide relatively specific therapeutic targets, such as lowering of blood pressure, induction of hypertrophy regression, performance of aortic valve replacement, and

treatment of ischemia by increasing myocardial blood flow and reducing myocardial oxygen demand.

Third, treatment should target the underlying mechanisms that are altered by the disease processes.



Reproduced with permission from Paulus et al. [7]. HFNEF: heart failure with normal ejection fraction LVEF: left ventricular ejection fraction LVEDVI: left ventricular end-diastolic volume indexed to body surface LV: left ventricular mPCW: mean pulmonary capillary wedge pressure LVEDP: left ventricular end-diastolic pressure TD: tissue Doppler LAVI: left atrial volume indexed to body surface area LVMI: left ventricular mass indexed to body surface area. See text for other abbreviations.

Fig (7): Diagnosis of Heart Failure with Normal Ejection Fraction[12], [36]

TABLE NO-3

Diastolic Heart Failure: Treatment[12]

Symptom-targeted treatment
Decrease pulmonary venous pressure
Reduce LV volume
Maintain atrial contraction
Prevent tachycardia
Improve exercise tolerance
Use positive inotropic agents with caution
Nonpharmacological treatment
Restrict sodium to prevent volume overload
Restrict fluid to prevent volume overload
Perform moderate aerobic exercise to improve cardiovascular conditioning, decrease heart rate, and maintain skeletal muscle function
Pharmacological treatment
Diuretics, including loop diuretics, thiazides, spironolactone
Long-acting nitrates
ß-Adrenergic blockers
Calcium channel blockers
Renin-angiotensin-aldosterone antagonists, including ACE inhibitors, angiotensin II receptor blockers, and aldosterone antagonists
Disease-targeted treatment
Prevent/treat myocardial ischemia
Prevent/regress ventricular hypertrophy
Mechanism-targeted treatment
Modify myocardial and extramyocardial mechanisms
Modify intracellular and extracellular mechanisms

3.101 SYMPTOM-TARGETED TREATMENT:

Decrease Diastolic Pressure:

The initial step in treating patients presenting with diastolic heart failure is to reduce pulmonary congestion by decreasing LV volume, maintaining synchronous atrial contraction, and increasing the duration of diastole by reducing heart rate LV diastolic pressures can be decreased by reducing total blood volume (eg, through fluid and sodium restriction or use of diuretics), decreasing central blood volume (nitrates), and blunting neurohumoral activation. Treatment with diuretics and nitrates should be initiated at low doses to avoid hypotension and fatigue. Hypotension can be a significant problem, because these patients have a very steep diastolic pressurevolume curve such that a small change in diastolic volume causes a large change in pressure and cardiac output.

One mechanism that causes fluid retention and an increase in central and systemic volume is activation of these neurohumoral systems. Therefore, treatment for diastolic heart failure might include agents such as ACE inhibitors, AT1 receptor antagonists, and aldosterone antagonists. In addition to promoting fluid retention, neurohumoral activation can have direct effects on cellular and extracellular mechanisms that contribute to the development of diastolic heart failure. Modulation of neurohumoral activation may also affect fibroblast

activity, interstitial fibrosis, intracellular calcium handling, and myocardial stiffness.

Tachycardia is poorly tolerated in patients with diastolic heart failure for several reasons.

First, rapid heart rates cause an increase in myocardial oxygen demand and a decrease in coronary perfusion time, which can promote ischemic diastolic dysfunction even in the absence of epicardial coronary disease, especially in patients with LV hypertrophy.

Second, a shortened diastole may cause incomplete relaxation between beats, resulting in an increase in diastolic pressure relative to volume.

Third, hearts with diastolic dysfunction exhibit a flat or even negative relaxation velocity–versus– heart rate relationship, so that as heart rate increases, relaxation rate does not increase or may even decrease, which can then cause diastolic pressures to increase β-Blockers and some calcium channel blockers can thus be used to prevent excessive tachycardia and produce a relative bradycardia. Although the optimal heart rate must be individualized, an initial goal might be a resting heart rate of 60 to 70 bpm with a blunted exercise-induced increase in heart rate.

Improve Exercise Tolerance:

Patients with diastolic heart failure have a marked limitation in exercise tolerance. There are a number of mechanisms responsible for this limitation. In patients with diastolic heart failure, the ability to use the Frank-Starling mechanism is limited despite the increased filling pressures because increased diastolic stiffness prevents the increase in LV end diastolic volume that normally accompanies exercise. The abnormal relaxation velocity–versus–heart rate relationship that exists in patients with diastolic heart failure prevents augmentation of relaxation velocity as heart rate increases during exercise. As a result, during exercise, diastolic pressure increases, the stroke volume fails to rise, and patients experience dyspnea and fatigue. In patients with diastolic heart failure, there is frequently an exaggerated rise in blood pressure in response to exercise that increases LV load and in turn further impairs myocardial relaxation and filling. β-Blockers, calcium channel blockers, and AT1 antagonists may have a salutary effect on symptoms and exercise capacity in many patients with diastolic heart failure.

Use Positive Inotropic Drugs With Caution: Positive Inotropic agents are generally not used in the treatment of patients with isolated diastolic heart failure because the ejection fraction is preserved, and there appears to be little potential benefit. Moreover, such drugs have the potential to

worsen the pathophysiological processes that cause diastolic heart failure. In contrast to long-term use, positive inotropic drugs may be beneficial in the short-term treatment of pulmonary edema associated with diastolic heart failure because they enhance SR function, promote more rapid and complete relaxation, increase splanchnic blood flow, increase venous capacitance, and facilitate diuresis. However, even short-term treatment with these agents may adversely affect energetics, induce ischemia, raise heart rate, and induce arrhythmias. Therefore, these agents should be used with caution, if they are used at all. Results of the Digitalis Investigation Group trial53 suggested that patients with heart failure and a normal ejection fraction may have fewer symptoms and fewer hospitalizations if they are treated with digitalis.

Differences between Pharmacological Treatment of Systolic and Diastolic Heart Failure:

With a number of notable exceptions, many of the drugs used to treat diastolic heart failure are in fact the same as those used to treat systolic heart failure. However, the rationale for their use, the pathophysiological process that is being altered by the drug, and the dosing regimen may be entirely different depending on whether the patient has systolic or diastolic heart failure. For example, β-blockers are now recommended for the treatment of both systolic and diastolic heart

failure. In diastolic heart failure, however, β-blockers are used to decrease heart rate, increase the duration of diastole, and modify the hemodynamic response to exercise. In systolic heart failure, β-blockers are used chronically to increase inotropic state and modify LV remodeling. In systolic heart failure, β-blockers must be titrated slowly and carefully over an extended time period. This is generally not necessary in diastolic heart failure. Diuretics are used in the treatment of both systolic and diastolic heart failure. However, the doses of diuretics used to treat diastolic heart failure are generally smaller than the doses used in systolic heart failure. Some drugs are used only to treat either systolic or diastolic heart failure but not both. For example, calcium channel blockers such as diltiazem, nifedipine, and verapamil have no place in the treatment of systolic heart failure. By contrast, each of these has been proposed as being useful in the treatment of diastolic heart failure.

Mechanism-Targeted Treatment (Future Directions):

An ideal therapeutic agent should target the underlying mechanisms that cause diastolic heart failure. Therefore, a therapeutic agent might improve calcium ho-meostasis and energetics, blunt neurohumoral activation, or prevent and regress fibrosis. Fortunately, some pharmaceutical agents that fit these design characteristics are

already in existence, and many more are under development.. Diastolic heart failure is now recognized as an important problem, guidelines for diagnosis have been developed .Three trials are now under way .Two of these trials target neurohumoral activation in the RAAS by inhibiting the angiotensin II receptor (Candesartan cilexetil in Heart failure Assessment of Reduction in Mortality and morbidity [CHARM] and Wake Forest). The third study targets intracellular calcium homeostasis using an agent that is proposed to improve SR calcium reuptake (MCC-135). With these 3 studies, and others that are currently under development, an effective treatment for diastolic heart failure will be more completely defined.

Materials & Methods

MATERIAL AND METHODS

Study involving 103 Patients of Heart Failure admitted in General Medical Ward of Coimbatore Medical College Hospital (CMCH) over the period of one year from September 2009 to September 2010.

All the patients were evaluated with

1. Thorough Histroy
2. Complete Physical Examination
3. Chest X-Ray
4. ECG
5. Complete Blood Count
6. Renal Function Test
7. Fasting Blood Sugar
8. Lipid Profile

After initial evaluation all patients were routinely underwent M-mode and Two Dimensional Echocardiography.

Study Design: Observational Study

Statistical Method: Continuous data were expressed as mean±SD (i.e. Age, SBP, DBP, LVEDD, LVESD and EF), age distribution between males and females compared with X^2 Test (Chi Square Test). P=0.05 Just Significant (JS) P<0.05 Significant(S), P<0.001 – Highly Significant (HS).

Collaborating Department: Cardiology

Inclusion Criteria: All patients with Signs and Symptoms of Heart Failure who fulfills the Framingham Criteria.

Exclusion Criteria:

1. Patients with Age Less than 12 years.
2. Valvular Heart Disease
3. Congenital Heart Disease
4. Established Renal Failure
5. Pregnant Women
6. Patients with CorPulmonale.

Observation and Analysis

OBSERVATIONS AND DATA ANALYSIS

103 Patients of Heart failure were analyzed. Among them 43(42%) were Heart Failure with Preserved Ejection Fraction (EF ≥ 50%) and 60(58%) were Heart Failure with Reduced Ejection Fraction (EF < 50%).

GRAPH: 1 DISTRIBUTION OF HEART FAILURE (HF)

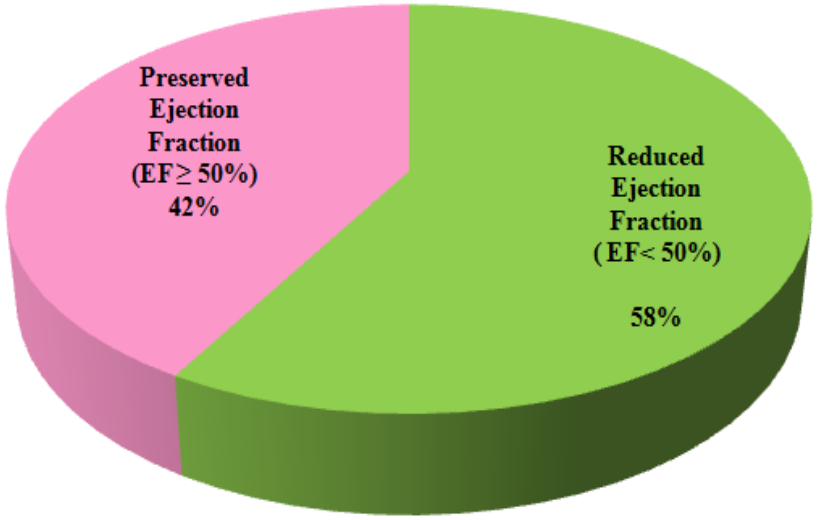
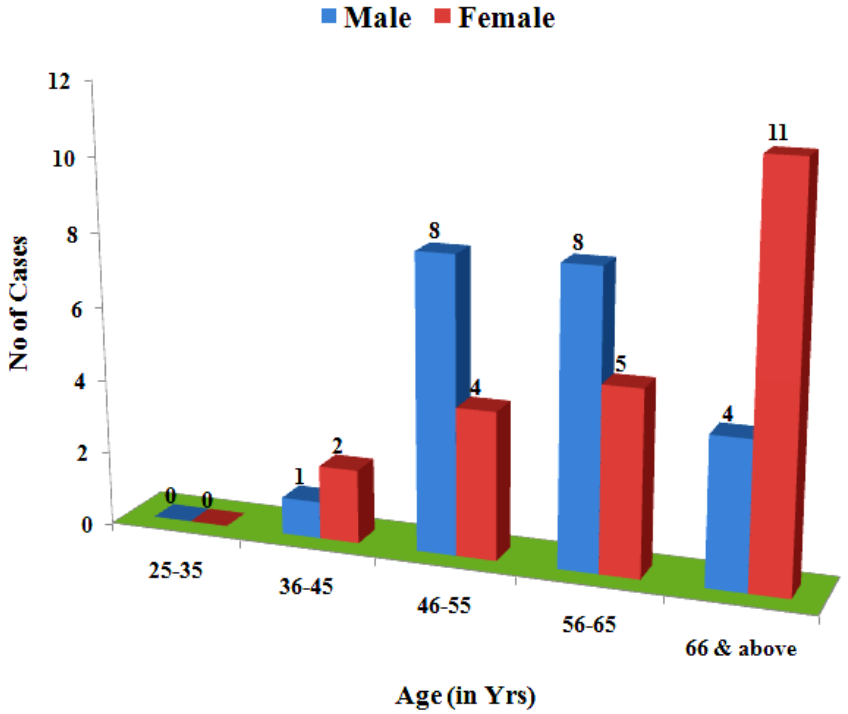


TABLE NO- 4

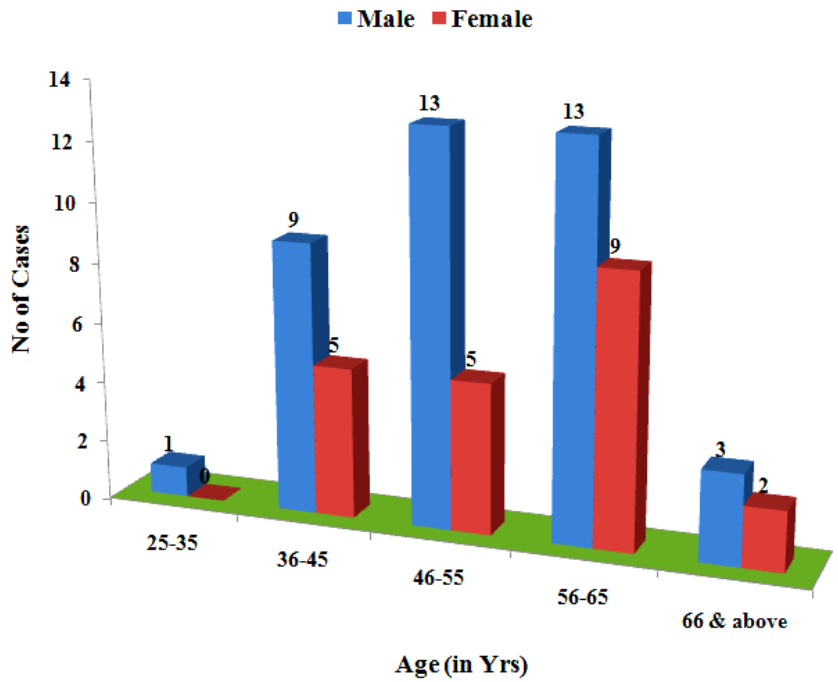
AGE AND SEX DISTRIBUTION

	EF < 50 (n=60)		EF ≥ 50 (n=43)	
AGE(in yrs)	Male	Female	Male	Female
25-35	1	0	0	0
36-45	9	5	1	2
46-55	13	5	8	4
56-65	13	9	8	5
66 & above	3	2	4	11
Total	39	21	21	22
Age(in Yrs)	51.97±10.25	54±10.73	57.43±9.37	62.86±12.17
Age(in Yrs)	52.68±10.38		60.21±11.11	

GRAPH: 2 AGE DISTRIBUTION HF WITH PRESERVED EF



GRAPH: 3 AGE DISTRIBUTION
HF WITH REDUCED EF



X^2 TEST	FEMALE	MALE	Total	Ratio (i.e FEMALE)
No of cases with EF ≥ 50%(n=43)	22	21	43	51.1627907
No of cases with EF < 50%(n=60)	21	39	60	35.00
Total	**43**	**60**	**103**	

The observed X^2 value was 2.69 which was much lower than 95% CI value which was 3.84. Female patients were more significant in HFPEF (F.M Ratio 51) is than HFrEF (F.M. Ratio 35)

Women with the age of 65 yrs and above group (25%) were mostly affected with HFPEF.

Mean age of HFPEF was 53±10yrs whereas 62±11yrs in HFrEF.

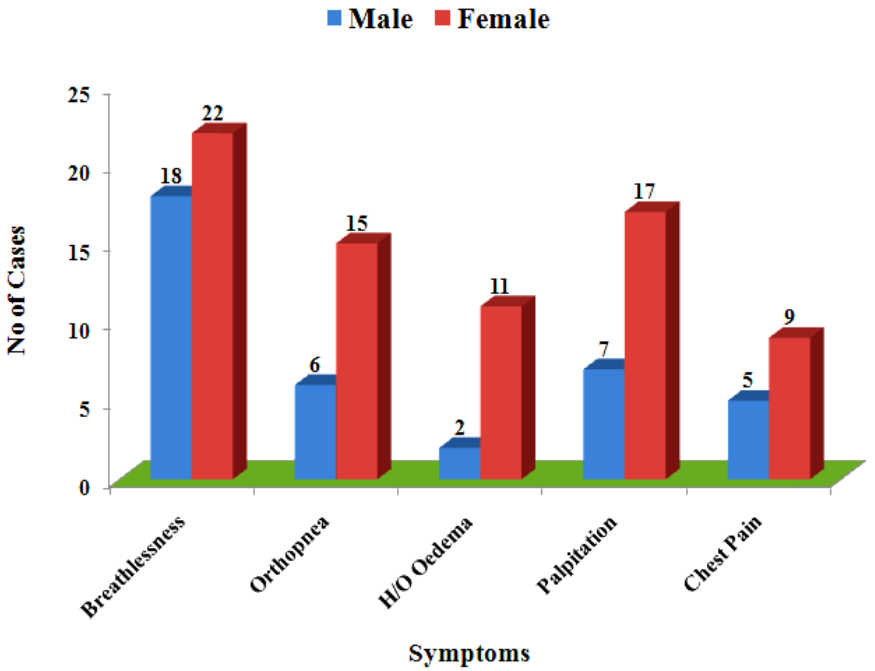
TABLE NO-5

SYMPTOMS PROFILE

	HF WITH PRESERVED EF (n=43)	**P Value**	**Significance**
Breathlessness	40	P <0.001	Highly Significant
Orthopnea	21	P <0.05	Significant
H/O Oedema	13	P=0.05	Just Significant
Palpitation	24	P <0.001	Highly Significant
Chest Pain	14	P=0.05	Just Significant
	HF WITH REDUCED EF (n=60)	P Value	Significance
Breathlessness	56	P<0.001	Highly Significant
Orthopnea	41	P<0.001	Highly Significant
H/O Oedema	46	P<0.001	Highly Significant
Palpitation	28	P<0.001	Highly Significant
Chest Pain	31	P<0.001	Highly Significant

Exertional breathlessness was the most common presenting Symptom (93%) in both types of HF. Palpitaion and Orthopnea were next most common presenting symptoms in HF. Edema legs in HFPEF was 30% whereas 77% in HFrEF.

GRAPH : 4 SYMPTOMS PROFILE
HF WITH PRESERVED EF(n=43)



GRAPH : 5 SYMPTOMS PROFILE
HF WITH REDUCED EF(n=60)

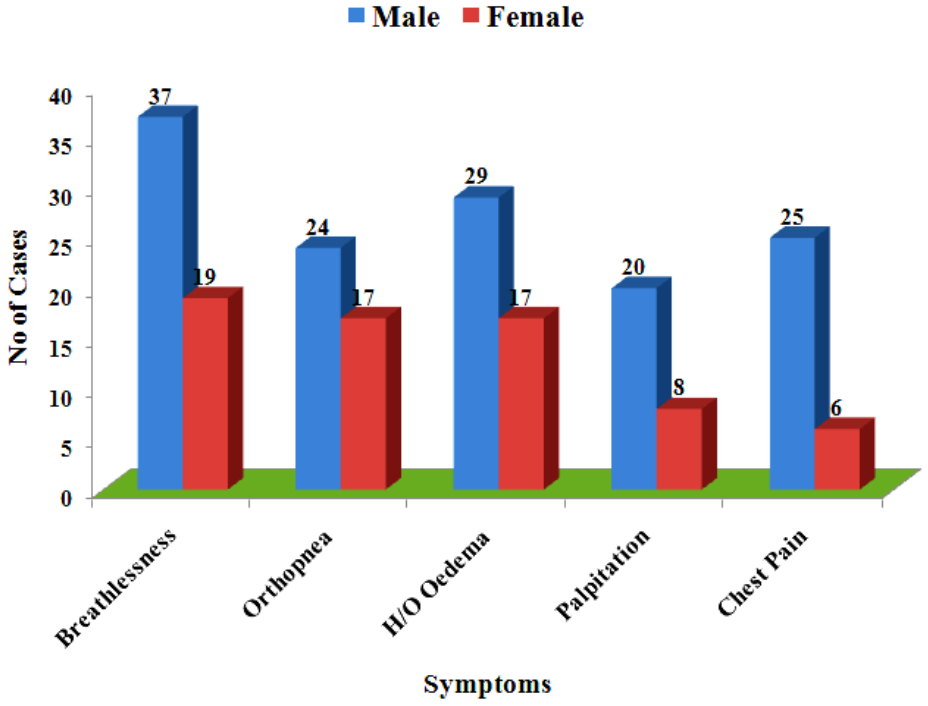
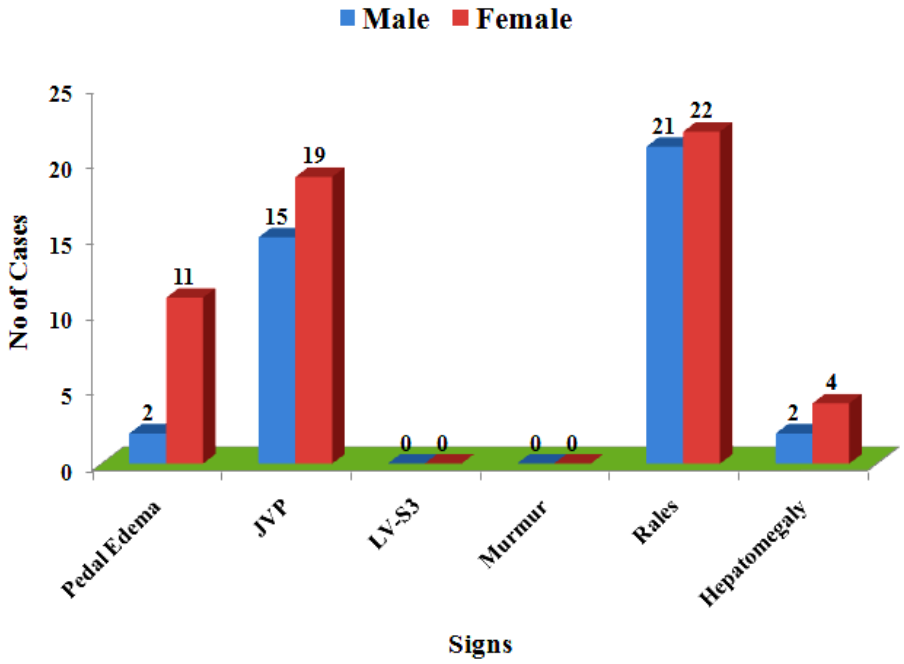


TABLE NO.-6

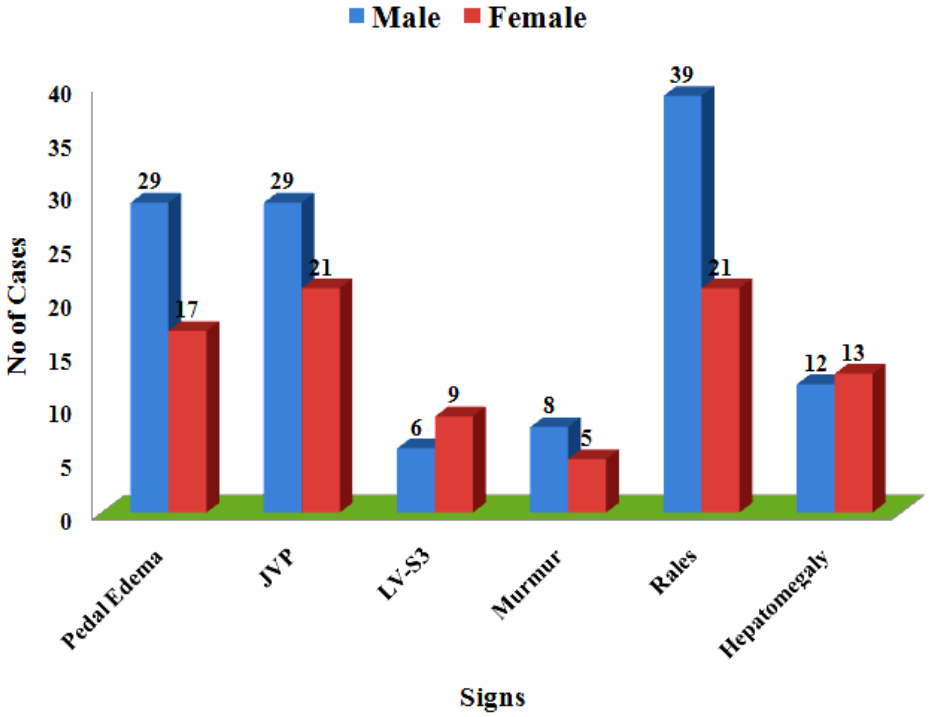
PHYSICAL SIGNS

	PRESERVED EF (n=43)	**P Value**	**Significance**
Pedal Edema	13	P=0.05	Just Significant
JVP	34	P<0.001	Highly Significant
LV-S3	0	P>0.05	Not Significant
Murmur	0	P>0.05	Not Significant
Rales	43	P<0.001	Highly Significant
Hepatomegaly	6	P>0.05	Not Significant
PULSE AF	4	P>0.05	Not Significant
PULSE ST	26	P<0.001	Highly Significant
PULSE VPC	8	P>0.05	Not Significant
PULSE NORMAL	5	P>0.05	Not Significant
SBP	148.33±15.29		
DBP	90.09±25.29		
	REDUCED EF (n=60)	P Value	Significance
Pedal Edema	46	P<0.001	Highly Significant
JVP	50	P<0.001	Highly Significant
LV-S3	15	P<0.05	Significant
Murmur	13	P<0.05	Significant
Rales	60	P<0.001	Highly Significant
Hepatomegaly	25	p<0.001	Highly Significant
PULSE AF	4	P>0.05	Not Significant
PULSE ST	31	P<0.001	Highly Significant
PULSE VPC	6	P>0.05	Not Significant
PULSE NORMAL	19	P<0.001	Highly Significant
SBP	120.24±`9.66		
DBP	80.67±15.52		

GRAPH : 6 SIGNS PROFILE
HF WITH PRESERVED EF (n=43)



GRAPH : 7 SIGNS PROFILE
HF WITH REDUCED EF(n=60)



Rales in the lung fields was present in 100% of HF patients and Elevated JVP was the 2nd most common sign.

Mean SBP was 148±15 mmHg in HFPEF whereas 120±10 mmHg in HFrEF.

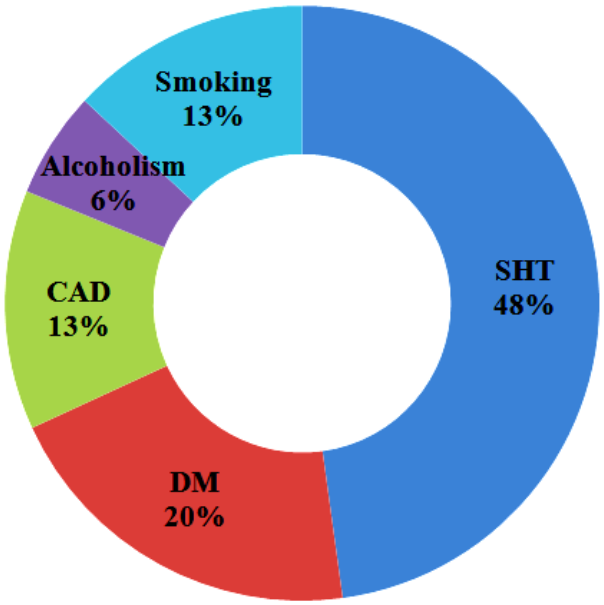
Mean DBP was 90±25 mmHg in HFPEF whereas 80±15 mmHg in HFrEF.

TABLE NO-7

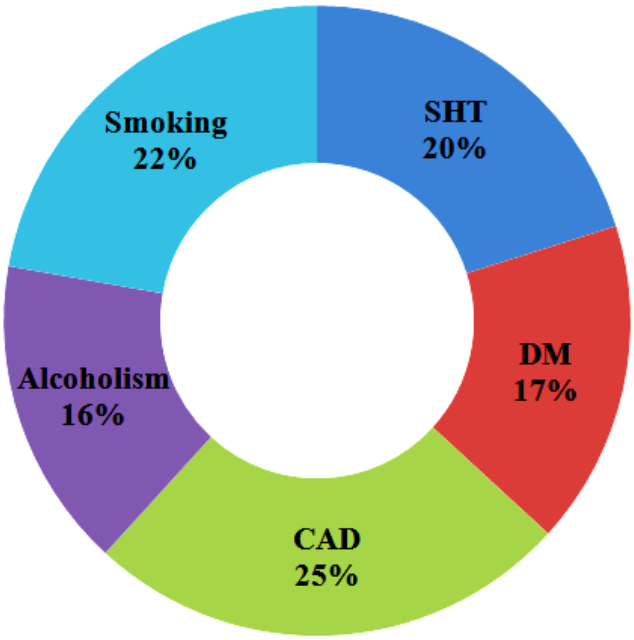
MAJOR RISK FACTORS

	PRESERVED EF (n=43)	P Value	Significance
SHT	33	P<0.001	Highly Significant
DM	14	P=0.05	Just Significant
CAD	9	P>0.05	Not Significant
Alcoholism	4	P>0.05	Not Significant
Smoking	9	P>0.05	Not Significant
	REDUCED EF (n=60)	P Value	Significance
SHT	29	P<0.001	Highly Significant
DM	24	P<0.001	Highly Significant
CAD	36	P<0.001	Highly Significant
Alcoholism	23	P<0.001	Highly Significant
Smoking	32	P<0.001	Highly Significant

GRAPH: 8 RISK FACTORS COMPLEX HF WITH PRESERVED EF(n=43)



GRAPH: 9 RISK FACTORS COMPLEX HF WITH REDUCED EF(n=60)



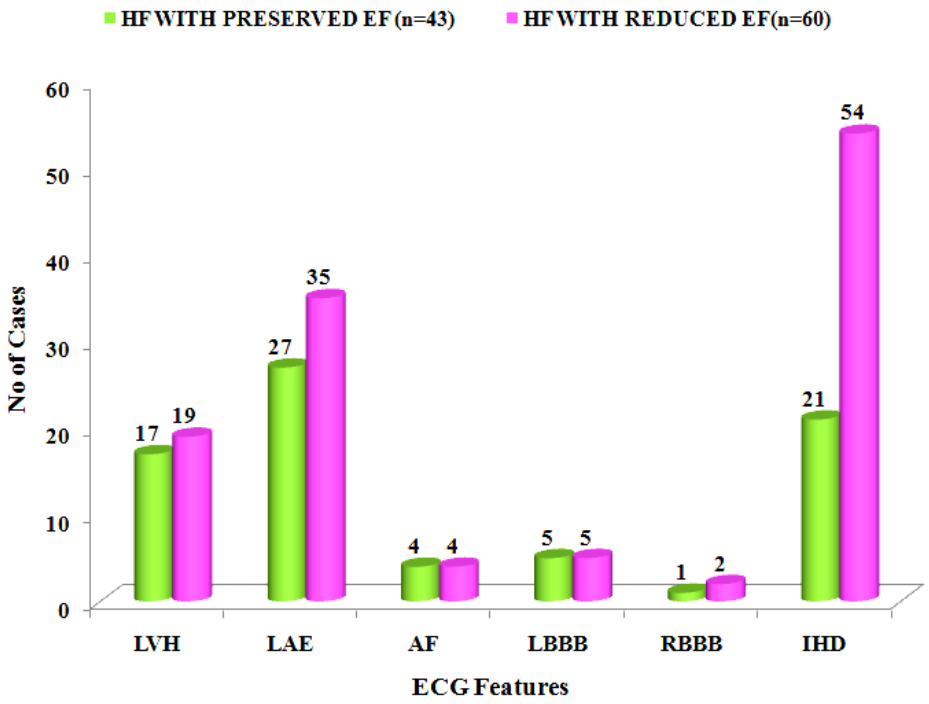
SHT was the most common risk factor in HFPEF whereas CAD in HFrEF.DM was significant risk factor in both types of HF. Alcoholism and smoking were significant in HFrEF than in HFPEF.

TABLE NO-8

ECG FEATURES

Features	**HF WITH PRESERVED EF(n=43)**	**P Value**	**Significance**
LVH	17	P<0.05	Significant
LAE	27	P<0.001	Highly Significant
AF	4	P>0.05	Not Significant
LBBB	5	P>0.05	Not Significant
RBBB	1	P>0.05	Not Significant
IHD	21	P<0.05	Significant
Features	HF WITH REDUCED EF(n=60)	P Value	Significance
LVH	19	P<0.05	Significant
LAE	35	P<0.001	Highly Significant
AF	4	P>0.05	Not Significant
LBBB	5	P>0.05	Not Significant
RBBB	2	P>0.05	Not Significant
IHD	54	P<0.001	Highly Significant

GRAPH: 10 ECG PROFILE



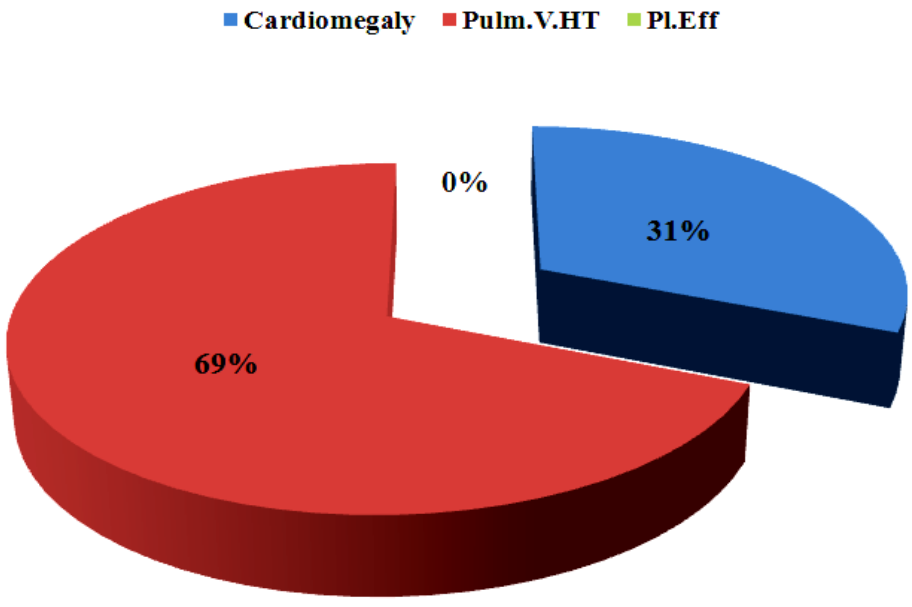
LAE was the significant manifestation in ECG (63%) in HFPEF, 58% in HFrEF. Evidence of IHD was 90% in HFrEF, 48% in HFPEF. 3rd common manifestation was LVH.AF (9%) in HFPEF (not significant), 7% in HFrEF (not significant).

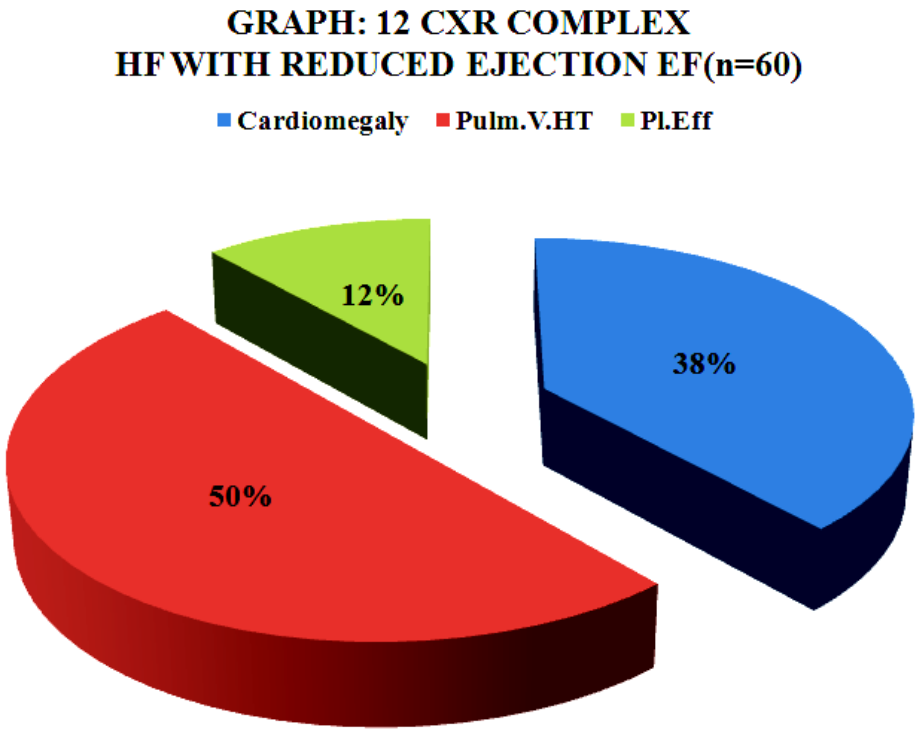
TABLE NO-9

CHEST X-RAY FINDINGS

Findings	HF WITH PRESERVED EF(n=43)	P Value	Significance
Cardiomegaly	14	P=0.05	Just Significant
Pulm.V.HT	31	P<0.0001	More Significant
Pl.Eff	0	P>0.05	Not Significant
Findings	HF WITH REDUCED EF(n=60)	P Value	Significance
Cardiomegaly	40	P<0.001	Highly Significant
Pulm.V.HT	52	P<0.001	Highly Significant
Pl.Eff	12	P=0.05	Just Significant

GRAPH: 11 CXR COMPLEX
HF WITH PRESERVED EF(n=43)





Pulmonary venus HT was the Highly Significant finding in both types of HF. Cardiomegaly and pleural effusion were significant in HFrEF than HFPEF.

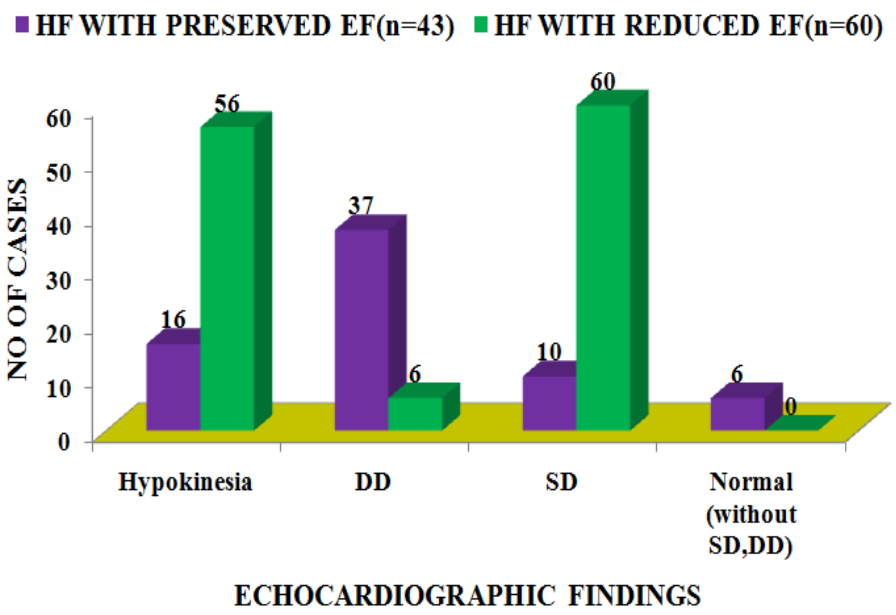
TABLE NO-10

ECHOCARDIOGRAPHIC FEATURES

	EF ≥ 50%	**EF < 50**
LVEDD	43.67±6.11	56.52±7.45
LVESD	29.93±4.48	45.88±7.11
LVEF	61.4%±7.8%	32.85%±8.14%

HF WITH PRESERVED EF (n=43)		**P Value**	**Significance**
Hypokinesia	16	P<0.05	Significant
DD	37	P<0.001	Highly Significant
SD	10	P>0.05	Not Significant
Normal (without SD,DD)	6	P>0.05	Not Significant
HF WITH REDUCED EF (n=60)		P Value	Significance
Hypokinesia	56	P<0.001	Highly Significant
DD	6	P>0.05	Not Significant
SD	60	P<0.001	Highly Significant
Normal (without SD,DD)	0	P>0.05	Not Significant

GRAPH : 13 ECHOCARDIOGRAPHIC FINDINGS



Mean EF in HFPEF was 61%±8%

Mean EF in HFrEF was 33%±8%

Mean LVEDD was 44±6 mm in HFPEF.

Mean LVEDD was 56.5±7 mm in HFrEF.

Observed E/A ratio were reduced to below one in HFPEF(Mean is 0.83).

Hypokinesia of Left Ventricle was 93% in HFrEF whereas 37% in HFPEF. DD was present in 86% of HFPEF, 10% in HFrEF. SD was present in all patients of HFrEF, 23% in HFPEF. 14% HF patients had no evidence of DD or SD in EF ≥ 50%.

Discussion

DISCUSSION

An estimated half of all patients with HF have preserved ejection fraction. The risk factors, clinical features, pathophysiology and course of the illness have extensively been studied recently.

In the present series 103 patients of heart failure fulfilling Framingham criteria who were admitted in General Medical Ward in Coimbatore Medical College Hospital, Coimbatore-18, during the period between September 2009 to September 2010 were studied.

Most have demonstrated minimal difference between clinical symptoms, signs, radiographic findings and have documented that none of the clinical features can be used to distinguish patients with HFPEF reliably from those with HFrEF. Assessment of EF with cardiac imaging is needed to distinguish HFPEF with HFrEF.

Present study can be seen as an assessment of the clinical course of HF with preserved EF as compared with that of HF with reduced EF from the same point in the evaluation of the disease.

In the present study, 42% of HF patients had an EF≥50%. Women >65yrs of age were more affected. Subtle differences were observed on physical examination. AF did not show significance in HFPEF (9%) as

well as in HFrEF (7%) whereas *Theophilus E Owan et al*.[34] studies showed that it was significant in HFPEF(41%). SHT, CAD and DM were the most significant risk factors in both types of heart failure. Smoking and alcoholism were not significant in HFPEF, but significant in HFrEF, whereas *Vasan et al*[5] studies concluded that no significant difference between the two types of heart failure.

Vasan et al[5] studies showed mean SBP was 143±24 mmHg and DBP was 73±13mmHg in HFPEF whereas present study showed mean SBP was148±15mmHg and mean DBP was 90±25mmHg in patients with HFPEF. Patients with HFrEF had mean SBP 120±10mmHg, mean DBP 80±15mHg.

ECG evidence of IHD was 48% in patients with HFPEF, 90% in patients with HFrEF. Evidence of LAE was highly significant in both types of Heart Failure. AF,RBBB, and LBBB were not significant in both types of Heart Failure.

Pulmonary venus hypertension (72%) was present in CXR of patients with HFPEF as compared to 87% in HFrEF. Cardiomegaly and pleural effusion were highly significant in HFrEF.

In Echocardiogram mean LVEDD is 44±6 mm in HFPEF and mean LVEDD is 56.5±7 mm in HFrEF. Observed E/A ratio were reduced to below one in HFPEF(mean is 0.83).

Micheal R Zile et al[4]. studied patients with HFNEF with Echocardiography to assess the diastolic function by the following parameters mainly

1. Left ventricular dimension.
2. Left ventricular wall thickness.
3. Transmitral flow velocities (E/A ratio).
4. Wall motion abnormalities.

Patients in present study were also evaluated with the above parameters and cardiac catheterization was not performed as facilities were inadequate.

Conclusion

CONCLUSION

1. 103 Patients of Heart failure were analyzed. Among them 42% of patients had EF ≥ 50% and 58% patients had EF < 50%.
2. Mean age of patients in HFPEF was 57± 9 for males, 62.8 ± 12 for females. Mean age of patients in HFrEF was 52 ± 10 for males, 54 ± 10 for females.
3. Women with the age of 65 yrs and above (25%) were mostly affected with HFPEF.
4. Exertional Breathlessness was the most common presenting symptom (93%) in both types of HF. Rales in the lung fields was present in 100% of patients with HF. Elevated JVP was the 2nd most common sign in both types of HF.
5. Mean SBP and DBP was higher in patients with HFPEF than in patients with HFrEF.
6. SHT was the most common risk factor in HFPEF (48%). CAD was the most common risk factor (25%) in HFrEF. DM was significant in both types HF. Alcoholism and smoking were significant in HFrEF than in HFPEF.
7. LAE was the significant manifestation in ECG, 63% in HFPEF and 58% in HFrEF. Evidence of IHD was 90% in HFrEF and 48% in HFPEF. 3rd common manifestation was LVH (significant) in both

types of HF. AF was 9% in HFPEF (not significant) and 7% in HFrEF (not significant).

8. Pulmonary venus hypertension was highly significant finding in both types of HF. Cardiomegaly and pleural effusion were significant in HFrEF than in HFPEF.
9. SHT was the most common risk factor in HFPEF whereas CAD in HFrEF.
10. DM was the significant risk factor in both types of HF. Alcoholism and smoking were significant in HFrEF than in HFPEF.
11. Observed E/A ratio were reduced to below one in HFPEF (Mean was 0.83).
12. About 10% of HF patients had no evidence of DD or SD. Those patients yet to be evaluated with cardiac catheterization and other advanced techniques.

Future Direction:

An ideal therapeutic agent should target the underlying mechanisms that cause diastolic heart failure. Diastolic heart failure is now recognized as an important problem, guidelines for diagnosis have been developed. Three trials are now under way. Two of these trials target neurohumoral activation. The third study targets intracellular calcium homeostasis.

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Annexures

ANNEXURE

PROFORMA

Name :

Age/Sex :

Occupation :

Address :

DOA :

DOD :

HISTORY

Shortness of breath

Orthopnea

Oedema by history

Palpitation

Chest pain

Easy fatiguability

PAST ILLNESS:

SHT

DM

CAHD

Smoking

Alcholism

Others

PHYSICAL EXAMINATION

Pedal edema

JVP/Neck vein distension

CVS

Pulse

BP

Apical impulse

Heart sounds

S3

Murmurs

RS

Rales/Rhonchi

ABDOMEN

Hepatomegaly

Free fluid

CNS

ECG

CXR

-Cardiomegaly

-Pulmonary venous hypertension

ECHOCARDIOGRAM

-Chamber dilatation

-Chamber hypertrophy

-Regional wall motion abnormality

-Systolic function

-Diastolic function

-Ejection fraction

-Others

INVESTIGATIONS

(1)*Complete hemogram*

Hb

TC

DC

Platelets

(2)*ESR*

(3)Fasting blood sugar

(4)Blood urea

Serum creatinine

(5)Serum electrolytes

-sodium

-potassium

(6)Fasting lipid profile

Total cholesterol

HDL

TGL

LDL

VLDL

(7)LFT

Total bilirubin - direct
- indirect

SGOT

SGPT

ALP

Total protein

-albumin

-globulin

(8)Urine R/E

Albumin

Sugar

Deposits

(9)USG Abdomen

FINAL MASTER CHART PRESERVED EF FOR STUDY

ANNEXURE (D)

				Symptoms					Signs									Risk Factors					ECG						CXR			Echocardiogram							
Sl.No.	Name	Age	Sex	Breathlessness	Orthopnea	H/O Oedema	Palpitation	Chest Pain	Pedal Edema	JVP	Pulse	SBP	DBP	LV-S3	Murmur	Rales	Hepatomegaly	SHT	DM	CAD	Alcoholism	Smoking	LVH	LAE	AF	LBBB	RBBB	IHD	Cardiomegaly	Pulm.V.HT	PLET	Hypokinesia	LVEDD	LVESD	LVEF	E/A ratio	DD	SD	Diagnosis
1	Lakshmi	60	F	P	N	P	P	N	P	P	ST	150	100	N	N	P	N	P	N	N	N	P	P	P	N	N	N	N	N	P	N	N	36	24	70%	1.17	N	N	HT HF
2	Nagarajan	38	M	P	P	P	N	N	P	P	ST	90	60	P	N	P	P	P	N	N	N	P	N	P	N	N	N	N	N	P	P	N	56	48	32%	1.34	N	P	HT HF
3	Lakshmi	65	F	P	P	P	N	N	P	P	X	100	60	N	N	P	P	P	N	P	N	N	P	P	N	N	N	P	P	P	N	P	63	49	30%	1.12	N	P	CAHD
4	Senthil Kumar	35	M	P	P	P	N	P	P	P	ST	90	50	N	P	P	N	P	N	P	P	P	P	P	N	N	N	P	P	P	N	P	69	56	25%	1.5	N	P	CAHD
5	Jagadeesan	68	M	P	N	N	N	N	N	P	ST	170	110	N	N	P	N	P	P	N	N	N	P	N	N	N	N	N	N	P	N	N	48	36	60%	0.83	P	N	HT DM
6	Palanisamy	65	M	P	N	P	P	P	P	P	ST	110	60	N	N	P	P	P	P	P	P	P	P	P	N	N	N	P	P	P	P	P	54	42	36%	1.62	N	P	CAHD
7	Kuruvammal	80	F	P	N	N	P	N	N	P	ST	190	90	N	N	P	N	P	N	N	N	N	P	N	N	N	N	N	N	P	N	N	42	29	67%	0.71	P	N	HT HF
8	Jayalaksmhi	60	F	P	P	P	P	N	P	P	VPC	130	80	P	N	P	N	N	N	P	N	N	N	P	N	P	N	N	P	P	N	P	45	35	44%	1.48	N	P	CAHD
9	Karrupathal	75	F	P	P	N	N	N	N	N	VPC	170	110	N	N	P	N	P	N	N	N	N	N	N	N	P	N	N	N	N	N	N	36	24	70%	0.55	P	N	HT HF
10	Muthammal	79	F	P	N	N	P	N	N	P	ST	180	96	N	N	P	N	P	P	N	N	N	P	N	N	N	N	N	N	P	N	N	43	32	56%	0.83	P	N	HT DM
11	Parameswari	43	F	P	P	P	P	P	P	P	ST	160	96	N	N	P	P	P	p	P	N	N	N	P	N	N	N	P	P	P	N	N	58	39	67%	0.82	P	N	CAHD
12	Nagaraju	44	M	P	P	P	P	N	P	P	ST	100	80	P	P	P	P	P	N	N	P	P	N	N	N	N	N	P	N	P	P	P	63	49	30%	1.46	N	P	CAHD
13	Parvathy	40	F	P	P	P	P	N	P	P	AF	120	90	N	N	P	P	N	N	N	N	N	N	N	P	N	N	N	P	P	N	N	45	36	45%	1.72	N	P	IDIO
14	Palaniswamy	55	M	N	N	N	P	N	N	P	ST	130	90	N	N	P	N	N	N	N	N	P	N	P	N	N	N	P	N	P	N	P	42	32	52%	0.87	P	P	CAHD
15	Saraswathy	70	F	P	P	N	P	P	N	P	VPC	140	80	N	N	P	N	P	N	N	N	N	N	P	N	P	N	P	P	P	N	P	44	29	50%	0.89	P	P	CAHD
16	Balakrishnan	66	M	P	N	P	P	N	P	P	X	120	70	N	N	P	N	N	N	N	N	N	N	N	N	N	N	P	N	P	N	P	45	36	45%	1.26	N	P	CAHD
17	Raman	58	M	P	N	N	P	P	N	P	X	110	70	N	N	P	N	P	N	N	P	P	N	N	N	N	N	P	N	P	N	P	48	36	60%	0.72	P	N	CAHD
18	Ragammal	65	F	P	P	P	P	P	P	P	AF	150	100	N	N	P	P	P	N	P	N	N	N	N	P	N	N	P	P	P	N	P	42	28	66%	0.72	P	N	EMF
19	Valliammal	75	F	P	P	P	P	P	P	P	X	100	70	P	P	P	P	N	N	P	N	N	N	P	N	N	N	P	P	P	P	P	66	55	24%	1.84	N	P	CAHD
20	Ragammal	60	F	P	P	N	N	P	N	P	VPC	130	80	P	N	P	P	P	N	P	N	N	N	P	N	N	N	P	P	P	N	P	64	53	24%	1.74	N	P	CAHD
21	Murugan	56	M	P	N	P	N	P	P	P	X	130	90	N	N	P	N	N	P	N	N	P	P	P	N	N	N	P	P	P	N	P	58	45	44%	1.01	P	P	CAHD
22	Govindammal	50	F	N	N	N	N	P	N	P	X	130	80	N	N	P	N	N	N	N	N	N	N	N	N	N	N	P	P	N	N	P	54	36	38%	1.48	N	P	CAHD
23	Raja	40	M	P	P	N	N	N	N	N	X	120	90	N	N	P	N	P	N	N	P	P	N	N	N	N	N	P	N	P	N	P	47	35	44%	1.1	N	P	CAHD
24	Manoharan	38	M	P	N	N	P	P	N	N	ST	140	90	N	N	P	N	N	P	P	N	N	N	N	N	N	N	P	P	N	N	P	66	56	28%	1.32	N	P	CAHD
25	Dhandapani	60	M	P	P	P	P	P	P	P	ST	100	70	N	N	P	N	P	P	P	N	N	N	P	N	N	N	P	P	N	N	P	61	51	35%	1.56	N	P	CAHD
26	Shobana	56	F	P	P	P	P	P	P	P	AF	100	60	N	N	P	N	N	P	N	N	N	N	P	P	N	N	N	P	P	N	N	43	23	56%	0.78	P	P	IDIO
27	Subramanian	61	M	P	N	N	N	N	N	P	ST	170	100	N	N	P	N	P	P	N	N	N	P	N	N	N	N	N	N	P	N	N	35	25	62%	0.61	P	N	HT DM
28	Venkatraman	50	M	P	P	P	N	P	P	P	ST	110	80	P	N	P	P	N	N	P	N	P	N	N	N	N	N	P	P	P	N	P	60	52	28%	1.23	N	P	CAHD
29	Aruvathal	60	F	P	P	P	P	P	P	P	ST	160	110	N	N	P	N	P	P	N	P	N	P	P	N	N	N	P	N	P	N	P	45	36	45%	1.38	N	P	CAHD
30	Muthuswamy	73	M	P	N	N	P	P	N	N	ST	130	90	N	N	P	N	P	P	N	P	P	N	N	N	N	N	P	N	P	N	P	64	54	20%	1.46	N	P	CAHD
31	Swaminathan	53	M	P	P	N	N	N	N	N	ST	100	80	N	N	P	N	P	P	N	N	P	N	P	N	N	N	P	N	N	N	P	54	46	25%	1.64	N	P	CAHD
32	Eswari	46	F	P	N	P	P	N	P	P	ST	150	100	N	N	P	N	P	N	N	N	N	N	P	N	N	N	N	P	P	N	N	48	28	60%	1.1	N	N	CAHD
33	Rajendran	60	M	P	N	N	P	N	N	P	X	180	100	N	N	P	N	N	N	P	N	N	N	N	N	N	N	P	N	P	N	P	43	32	57%	0.9	P	N	CAHD
34	Proma	41	F	P	P	P	N	P	P	P	ST	140	90	N	N	P	P	N	N	N	N	N	P	P	N	N	N	P	P	P	P	P	63	49	30%	1.32	N	P	CAHD
35	Vellingri	48	M	P	N	P	N	N	P	P	X	100	50	N	N	P	P	N	N	N	P	P	N	N	N	N	N	P	N	P	N	N	54	33	75%	0.76	P	N	IDIO
36	Subbathal	75	F	P	P	N	N	N	N	N	VPC	160	110	N	N	P	N	P	N	N	N	N	N	N	N	P	N	N	N	N	N	N	36	24	70%	0.56	P	N	HT HF

ANNEXURE (D)

				Symptoms					Signs								Risk Factors					ECG						CXR			Echocardiogram							
Sl.No.	Name	Age	Sex	Breathlessness	Orthopnea	H/O Oedema	Palpitation	Chest Pain	Pedal Edema	JVP	Pulse	SBP	DBP	LV-S3	Murmur	Rales	Hepatomegaly	SHT	DM	CAD	Alcoholism	Smoking	LVH	LAE	AF	LBBB	RBBB	IHD	Cardiomegaly	Pulm.V.HT	PLET	Hypokinesia	LVEDD	LVESD	LVEF	E/A ratio	DD	SD	Diagnosis
41	Dhanalakshmi	46	F	P	P	P	P	P	P	P	ST	170	100	N	N	P	P	P	N	P	N	N	N	P	N	N	N	P	P	P	N	N	58	39	67%	1.08	N	N	CAHD
42	Papammal	68	F	P	P	N	N	N	N	P	ST	140	90	N	N	P	N	P	N	N	N	N	N	P	N	N	N	N	P	P	N	N	43	33	56%	0.8	P	N	HT HF
43	Padmini	48	F	P	P	P	N	N	P	P	X	126	92	P	P	P	P	N	N	P	N	N	N	N	N	N	N	P	P	P	N	P	46	39	47%	0.7	P	P	CAHD
44	Chinna raj	49	M	P	N	P	N	P	P	N	X	100	60	N	N	P	N	N	N	P	P	P	N	N	N	N	N	P	N	P	N	P	56	48	32%	1.44	N	P	CAHD
45	Bommannan	60	M	P	N	P	P	P	P	P	ST	110	90	N	N	P	N	P	N	P	P	P	N	P	N	N	N	P	N	P	N	P	60	52	26%	1.68	N	P	CAHD
46	Ponnuswamy	47	M	P	P	N	N	P	N	P	X	90	60	N	P	P	N	N	N	P	P	P	P	P	N	N	N	P	P	P	N	P	58	44	32%	1.82	N	P	CAHD
47	Peumal	38	M	P	P	N	N	N	N	N	ST	160	98	N	N	P	N	P	N	N	N	N	N	N	N	N	N	N	N	N	N	N	35	26	62%	0.84	P	N	HT HF
48	Ramanathan	48	M	P	N	N	N	N	N	N	ST	180	100	N	N	P	N	P	P	N	N	N	P	P	N	N	N	P	N	N	N	P	41	29	66%	0.78	P	N	CAHD
49	Ramba	48	F	P	P	P	N	N	P	P	X	120	80	P	P	P	P	N	N	P	N	N	N	N	N	N	N	P	P	P	N	P	46	39	47%	0.7	P	P	CAHD
50	Natesen	47	M	P	P	P	P	N	P	P	AF	140	90	N	P	P	N	N	P	P	N	P	N	P	P	N	N	P	P	P	N	P	54	46	25%	1.64	N	P	CAHD
51	Kuruvammal	60	F	P	N	P	N	N	P	P	ST	170	130	N	N	P	N	P	N	P	N	N	P	P	N	N	N	P	P	P	N	P	54	43	35%	1.28	N	P	CAHD
52	Rangaswamy	63	M	P	P	P	P	P	P	P	ST	140	100	N	N	P	P	N	N	P	N	N	N	P	N	N	N	P	P	P	N	P	66	55	24%	1.12	N	P	CAHD
53	Ramaswamy	65	M	P	P	P	P	N	P	P	ST	100	60	N	N	P	P	P	P	P	P	P	P	P	N	N	N	P	P	P	P	P	64	53	24%	1.32	N	P	CAHD
54	Ramaswamy	48	M	P	N	N	N	N	N	N	ST	180	100	N	N	P	N	P	P	N	N	N	P	P	N	N	N	P	N	N	N	P	41	29	66%	0.78	P	N	CAHD
55	Thanam	60	F	P	P	P	P	P	P	P	ST	160	110	N	N	P	N	P	P	P	P	N	P	P	N	N	N	P	N	P	N	P	52	46	38%	1.54	N	P	CAHD
56	Balaraman	56	M	P	N	P	P	N	P	P	X	120	86	N	N	P	N	N	N	N	N	p	N	N	N	N	N	P	N	P	N	P	45	36	45%	1.32	N	P	CAHD
57	Balamurugan	61	M	P	N	P	P	P	P	P	ST	110	90	N	N	P	N	P	p	P	P	P	N	P	N	N	N	P	N	P	N	P	54	46	25%	1.48	N	P	CAHD
58	Thangam	48	M	P	N	P	N	P	P	N	X	100	60	N	N	P	N	N	N	P	P	P	N	N	N	N	N	P	N	P	N	P	56	48	32%	1.54	N	P	CAHD
59	Thayammal	45	F	P	P	P	P	P	P	P	ST	170	100	N	N	P	P	P	p	P	N	N	N	P	N	N	N	P	P	P	N	N	58	39	67%	0.8	P	N	CAHD
60	Dhandapani	60	M	P	P	P	P	P	P	P	ST	100	70	N	N	P	N	P	P	P	N	N	N	P	N	N	N	P	P	N	N	P	61	51	35%	1.1	N	P	CAHD
61	Velammal	46	F	P	N	P	P	N	P	P	ST	150	100	N	N	P	N	P	N	N	N	N	N	P	N	N	N	N	P	P	N	N	48	28	60%	1.1	N	N	CAHD
62	Indira	49	F	N	N	N	N	P	N	P	X	130	80	N	N	P	N	N	N	N	p	N	N	N	N	N	p	P	P	P	N	N	P	54	36	38%	1.38	N	P	CAHD
63	Hariharan	62	M	P	N	N	N	N	N	P	ST	170	100	N	N	P	N	P	P	N	N	N	P	N	N	N	N	N	N	N	P	N	N	35	25	62%	0.61	P	N	HT DM
64	Mallika	61	F	P	P	P	P	N	P	P	VPC	130	80	P	N	P	N	N	N	P	N	N	N	P	N	P	N	N	P	P	N	P	45	35	44%	1.42	N	P	CAHD
65	Kalyani	80	F	P	N	N	P	N	N	P	ST	190	90	N	N	P	N	P	P	N	N	N	P	N	N	N	N	N	N	P	N	N	43	32	56%	0.88	P	N	HT DM
66	Thangal	60	F	P	N	P	N	N	P	P	ST	170	110	N	N	P	N	P	N	P	N	N	P	P	N	N	P	P	P	P	N	P	60	52	28%	1.46	N	P	CAHD
67	Mariammal	62	F	P	N	P	P	N	P	P	ST	144	96	N	N	P	N	P	N	N	N	P	P	P	N	N	N	N	N	P	N	N	48	28	80%	1.17	N	N	HT HF
68	Geetha	36	F	P	P	P	N	N	P	P	X	100	60	N	N	P	P	P	N	P	N	N	P	P	N	N	N	P	P	P	N	P	62	53	26%	1.36	N	P	CAHD
69	Vijayan	36	M	P	N	N	P	P	N	N	ST	136	86	N	N	P	N	N	P	P	N	N	N	N	N	N	N	P	P	N	N	P	66	56	28%	1.26	N	P	CAHD
70	Nallanathan	53	M	P	P	N	N	N	N	N	ST	156	98	N	N	P	N	P	N	N	N	N	P	P	N	N	N	N	N	N	N	N	35	26	62%	0.84	P	N	HT HF
71	Maran	56	M	P	N	P	N	P	P	P	X	130	90	N	N	P	N	N	P	N	N	P	P	P	N	N	N	P	P	P	N	P	45	36	43%	1.01	P	P	CAHD
72	Sathasivam	50	M	N	P	P	N	P	P	P	VPC	110	70	N	N	P	N	N	N	N	N	P	N	N	N	N	N	P	N	P	N	P	56	48	32%	1.58	N	P	CAHD
73	Damodaran	70	M	P	N	N	P	P	N	N	ST	130	88	N	N	P	N	P	P	N	P	P	N	N	N	N	N	P	N	P	N	P	66	54	20%	1.68	N	P	CAHD
74	Natarajan	37	M	P	P	P	N	N	P	P	ST	100	70	P	N	P	P	P	N	N	N	P	N	P	N	N	N	N	N	P	P	N	54	46	30%	1.76	N	P	HT HF
75	Palanivel	61	M	P	N	P	P	P	P	P	ST	118	70	N	N	P	P	P	P	P	P	P	P	P	N	N	N	P	P	P	P	P	52	40	36%	1.42	N	P	CAHD
76	Thangadurai	58	M	N	N	N	P	N	N	P	ST	130	90	N	N	P	N	N	N	N	N	P	N	P	N	N	N	P	N	P	N	P	44	34	52%	0.68	P	P	CAHD
77	Chellakannu	66	F	P	P	N	P	N	N	P	ST	130	90	N	N	P	N	P	P	N	N	N	N	P	N	N	P	N	P	P	N	N	41	29	66%	0.8	P	N	HT DM
78	Chellthai	41	F	P	P	P	P	N	P	P	AF	120	90	N	N	P	P	N	N	N	N	N	N	N	P	N	N	N	P	P	N	N	46	37	45%	1.24	N	P	IDIO
79	Rukmani	57	F	P	P	P	P	P	P	P	AF	120	70	N	N	P	N	N	N	N	N	N	N	P	P	N	N	N	P	P	N	N	43	32	56%	0.8	P	N	IDIO
80	Ponnaiyan	46	M	P	P	N	N	P	N	P	X	100	60	N	P	P	N	N	N	P	P	P	P	P	N	N	N	P	P	P	N	P	58	44	32%	1.28	N	P	CAHD

ANNEXURE (D)

				Symptoms					Signs									Risk Factors					ECG						CXR			Echocardiogram							
Sl.No.	Name	Age	Sex	Breathlessness	Orthopnea	H/O Oedema	Palpitation	Chest Pain	Pedal Edema	JVP	Pulse	SBP	DBP	LV-S3	Murmur	Rales	Hepatomegaly	SHT	DM	CAD	Alcoholism	Smoking	LVH	LAE	AF	LBBB	RBBB	IHD	Cardiomegaly	Pulm.VHT	PLEU	Hypokinesia	LVEDD	LVESD	LVEF	E/A ratio	DD	SD	Diagnosis
81	Mutharasu	70	M	P	P	N	N	P	N	P	VPC	130	84	N	N	P	N	P	N	P	N	N	P	P	N	N	N	P	N	N	N	P	40	25	50%	0.94	P	P	CAHD
82	Saradha	44	F	P	P	P	N	P	P	P	ST	138	88	N	N	P	P	N	P	N	N	N	P	P	N	N	N	P	P	P	P	P	60	46	30%	1.34	N	P	CAHD
83	Nambiyan	44	M	P	P	P	P	N	P	P	ST	98	76	P	P	P	P	P	P	N	P	P	N	N	N	N	N	P	N	P	P	P	60	46	30%	1.32	N	P	CAHD
84	Arasu	59	M	N	N	N	P	N	N	P	ST	132	88	N	N	P	N	N	P	N	N	P	N	P	N	N	N	P	N	P	N	P	44	34	52%	0.66	P	P	CAHD
85	Asirvadham	74	M	P	P	N	N	P	N	P	VPC	130	80	N	N	P	N	P	N	P	N	N	P	P	N	N	N	P	N	N	N	P	43	28	50%	0.88	P	P	CAHD
86	Suresh	47	M	P	P	P	P	N	P	P	AF	150	96	N	P	P	N	N	P	P	P	P	N	P	P	N	N	P	P	P	N	P	54	46	25%	1.44	N	P	CAHD
87	Padma	46	F	P	P	P	N	N	P	P	ST	130	90	P	P	P	P	P	N	P	N	N	N	N	N	N	N	P	P	P	N	P	47	35	44%	0.76	P	P	CAHD
88	Abdul Kathar	56	M	P	P	N	N	N	N	N	X	130	90	N	N	P	N	P	P	N	P	P	N	N	N	N	N	P	N	P	N	P	49	37	44%	1.4	N	P	CAHD
89	Haji Mustfa	62	M	P	N	N	P	N	N	P	X	176	100	N	N	P	N	N	N	P	N	N	N	N	N	N	N	P	N	P	N	P	43	30	55%	0.86	P	N	CAHD
90	Chellapandi	60	M	P	N	N	P	P	N	P	X	114	70	N	N	P	N	P	P	N	P	P	N	N	N	N	N	P	N	P	N	P	48	36	60%	0.68	P	N	CAHD
91	Jhon Peter	40	M	P	P	P	P	N	P	P	ST	100	60	N	N	P	P	P	P	P	P	P	P	P	N	N	N	P	P	P	P	P	64	53	24%	1.2	N	P	CAHD
92	Edward Raj	50	M	P	N	N	N	N	N	N	ST	170	96	N	N	P	N	P	P	N	N	N	P	P	N	N	N	P	N	N	N	P	41	29	66%	0.7	P	N	CAHD
93	Rathanavelu	65	M	P	P	P	P	P	P	P	ST	138	98	N	N	P	P	N	N	P	N	N	N	P	N	N	N	P	P	P	N	P	66	55	24%	1.3	N	P	CAHD
94	Duraipandi	55	M	P	N	P	N	P	P	P	X	140	90	N	N	P	N	N	P	N	N	P	P	P	N	N	N	P	P	P	N	P	45	36	43%	1.01	P	P	CAHD
95	Fathima	68	F	P	P	N	N	N	N	P	ST	146	92	N	N	P	N	P	N	N	N	N	N	P	N	N	N	N	P	P	N	N	43	33	56%	0.8	P	N	HT HF
96	Vijaya	68	F	P	P	N	P	P	N	P	VPC	130	80	N	N	P	N	P	N	N	N	N	N	P	N	P	N	P	P	P	N	P	48	33	50%	0.79	P	P	CAHD
97	Arul Murugan	37	M	P	P	P	N	P	P	P	ST	110	60	N	P	P	N	P	N	P	P	P	P	P	N	N	N	P	P	P	N	P	67	54	25%	1.6	N	P	CAHD
98	Hajira	73	F	P	P	N	N	N	N	N	VPC	160	110	N	N	P	N	P	N	N	N	N	N	N	N	P	N	N	N	N	N	N	36	24	70%	0.58	P	N	HT HF
99	Saritha	58	F	P	P	N	N	P	N	P	VPC	120	90	P	N	P	P	P	N	P	N	N	N	N	N	P	N	P	P	P	N	P	63	52	24%	1.18	N	P	CAHD
100	Vivkekandan	55	M	P	P	N	N	N	N	N	ST	110	80	N	N	P	N	P	P	N	N	P	N	P	N	N	N	P	N	N	N	P	54	46	25%	1.7	N	P	CAHD
101	Saira Banu	72	F	P	P	P	P	P	P	P	X	130	70	P	P	P	P	N	p	P	N	N	N	P	N	P	N	P	P	P	P	P	66	57	24%	1.42	N	P	CAHD
102	Akbar Babu	46	M	P	N	P	N	N	P	P	ST	100	50	N	N	P	P	N	N	N	P	P	N	N	N	N	N	P	N	P	N	N	54	33	75%	0.66	P	N	IDIO
103	Joseph Luke	48	M	P	P	P	N	P	P	P	ST	110	80	P	N	P	P	N	N	P	p	P	N	N	N	N	N	P	P	P	N	P	66	50	28%	1.34	N	P	CAHD

P- PRESENT
N- NOT PRESENT

LIST OF ABBREVIATION

HFNEF, HFnlEF	Heart Failure with Normal Ejection Fraction
HFPEF	Heart Failure with Preserved Ejection Fraction
HF	Heart Failure
AF	Atrial Fibrillation
AGE	Advanced Glycation End product
ASD	Atrial Septal Defect
BNP	Brain Natriuretic Peptide
bpm	beats per minute
CAD	Coronary Atery Disease
CAHD	Coronary Atery Heart Disease
CNS	Central Nervous System
CVP	Central Venus Pressure
CVS	Cardio Vascular System
CXR	Chest X-Ray
DBP	Diastolic Blood Pressure
DD	Diastolic Dysfunction
DM	Diabetes Mellitus
ECG	Electrocardiogram
EDV	End Diastolic Volume
EF	Ejection Fraction
ESV	End Systolic Volume
HFrEF	Heart Failure with Reduced Ejection Fraction

HOCM	Hypertrophic Obstructive Cardiomyopathy
HT	Hypertension
IHD	Ischemic Heart Disease
JVP	Jugular Venus Pulse
LAE	Left Atrial Enlargement
LBBB	Left Bundle Branch Block
LV	Left Ventricle
LVEDD	Left ventricular End Diastolic diameter
LVESD	Left ventricular End Systolic diameter
LVH	Left Ventricle hypertrophy
NT-proBNP	N-terminal–pro-BNP
RBBB	Right Bundle Branch Block
RS	Respiratory System
RV	Rgith Ventricle
SBP	Systolic Blood Pressure
SD	Systolic Dysfunction
SHT	Systemic Hypertension
SV	Stroke Volume
VO2	oxygen uptake
BP	Blood Pressure